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Application Data Sheet

No.125

GC-MS
Gas Chromatograph Mass Spectrometer

Analysis of Naphthalene in a Working Environment

Working environment measurements are obligatory under the Japanese Industrial Safety and Health Act. The purpose is to prevent health problems in workers caused by toxic factors in the working environment. In November 2015, naphthalene was added to the list of specified chemical substances in an amendment to the Ordinance on Prevention of Hazards Due to Specified Chemical Substances, Working Environment Measurement Standards, etc.
In this article, an investigation was performed using a gas chromatograph mass spectrometer (GC-MS), in accordance with the naphthalene standard measurement analysis method. This method is outlined in appendix 4 of separate volume 06, naphthalene detailed risk assessment, of the report by the investigative commission on risk assessment for chemical substances (first report, 2014).
From the results of this investigation, it was evident that naphthalene in the working environment could be analyzed with high accuracy.

Experiment

The sampling conditions were indicated as follows: The sampling flow rate was 0.02 L/min or 0.1 L/min, and the sampling times were 10 minutes (fixed point) and 240 minutes (individual exposure). As a result, the air sampling quantities were 0.2 L or 1.0 L for the fixed point, and 4.8 L or 24 L for the individual exposure. When the air sampling quantity was 1.0 L (fixed point), the standard solution concentration, which is equivalent to a control concentration of 10 ppm, was 10.5 μg/mL. In addition, when the air sampling quantity was 4.8 L (individual exposure), the standard solution concentration, which is equivalent to a control concentration of 10 ppm, was 50.4 μg/mL.
Standard solutions at 0.1 μg/mL, 0.2 μg/mL, 1 μg/mL, 2 μg/mL, 10 μg/mL, 20 μg/mL, and 100 μg/mL were prepared by diluting the naphthalene standard product with dichloromethane, in order to enable measurements in a range from 1/100th of the control concentration to 2x the control concentration. In this case, the solutions were prepared in such a way that the naphthalene-d8 concentration in each of the standard solutions was 2 μg/mL. Each of these prepared standard solutions was measured using the analytical conditions in Table 1.

Table 1: Analytical Conditions

Gas Chromatograph Mass Spectrometer: GCMS-QP2020

GC		MS	
Column:	Stabilwax (30 m × 0.25 mm I.D., 0.5 μm)	Ion Source Temperature:	200 °C
		Interface Temperature:	240 °C
Sample Injection Volume:	1 μL	Ionization Current:	20 μA (High concentration)
Injection Port Temperature:	230 °C		
Injection Mode:	Split	Measurement Mode:	Scan
Split Ratio:	20	Measurement Mass Range:	*m/z* 50 - 250
Control Mode:	Constant linear velocity (47 cm/sec)	Event Time:	0.3 sec
Oven Temperature:	50 °C (1 min) → (20 °C/min) → 240 °C (3 min)	Measurement Mode:	SIM
		Monitor Ion:	
		Naphthalene:	128, 127, 129
		Naphthalene-d8:	136, 137, 134
		Event Time:	0.3 sec

Results

Fig. 1 shows the total ion current chromatograms obtained by measuring the 10 μg/mL naphthalene standard solution. For naphthalene, a calibration curve was created with a concentration range of 0.1 μg/mL to 100 μg/mL. The results for the correlation coefficient (R) for the calibration curve were a favorable 0.99994 or higher (Fig. 2). Fig. 3 shows the SIM chromatogram for the 0.1 μg/mL standard solution. In addition, the 0.1 μg/mL standard solution was measured five times, and the repeated analysis accuracy was calculated. The result for the repeated analysis accuracy was a favorable 2 % or less. The results are shown in Table 2.

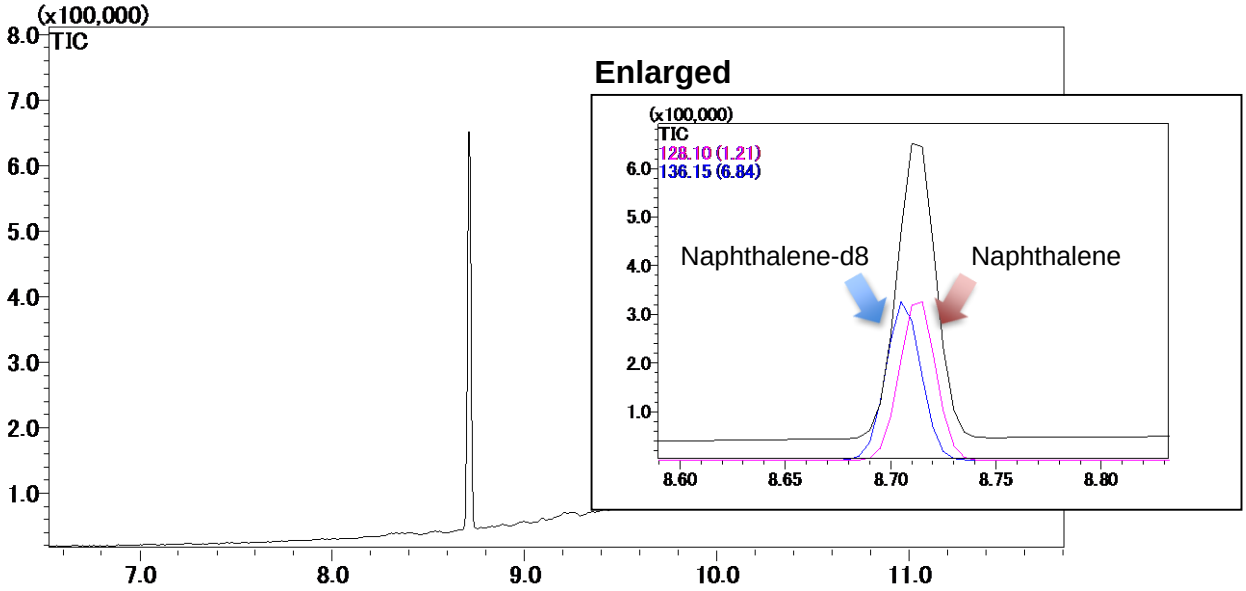

Fig. 1: Total Ion Current Chromatograms for Naphthalene and Naphthalene-d8

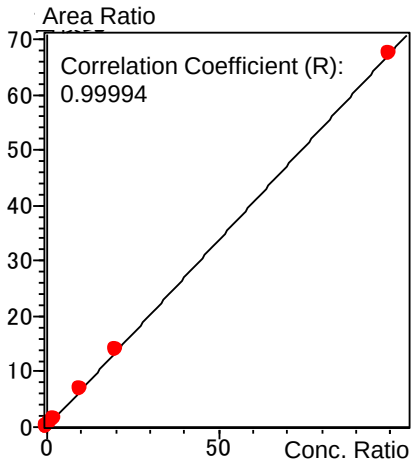

Fig. 2: Calibration Curve
(0.1 μg/mL to 100 μg/mL; Internal Standard Method)

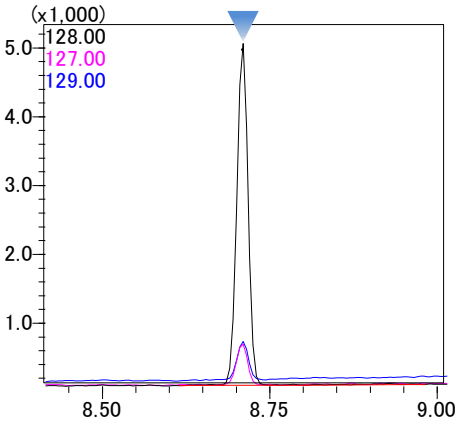

Fig. 3: SIM Chromatograms for the 0.1 μg/mL Standard Solution

Table 2: Repeated Analysis Accuracy (n=5)

Concentration units: μg/mL

ID	Compound Name	Data 1	Data 2	Data 3	Data 4	Data 5	Average	Standard Deviation	Coefficient of Variation (%)
1	Naphthalene	0.0925	0.0912	0.0902	0.0902	0.0911	0.0910	0.0009	1.04

Conclusions

Using the GCMS-QP2020, it was possible to analyze naphthalene in a working environment with good accuracy. Combining this with the Twin Line MS system would also enable the analysis of organic solvents in the working environment (including some of the specified chemical substances), reported in Application Data Sheets No. 118 and No. 119.

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