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Application Data Sheet

No.16

GC
Gas Chromatograph

Analysis of Insulation Gas SF_6 by the GC-BID System

Sulfur hexafluoride (SF_6) gas has superior insulation properties and is highly stable. For this reason, it is used as the insulation in gas-insulated transformers, breakers, and other electrical equipment. Moreover, as a tracer gas, it is widely used in a variety of fields. On the other hand, SF_6 is known to be a highly significant greenhouse effect gas, and has been targeted for emissions control by the COP3 Kyoto Protocol.
Conventional methods specify analyzing SF_6 using an ECD detector, which is capable of the highly sensitive detection of electrophilic compounds. However, this method results in some unresolved issues, such as the accuracy of quantitation in high concentration ranges and the fact that radioisotopes need to be used, which involves tedious and complicated procedural work. With a barrier ionization discharge detector (BID), the highly sensitive detection of a wide range of components is possible*1. This detector offers both the stability and high sensitivity of conventional general-purpose detectors by incorporating unique barrier ionization discharge technology.
This data sheet introduces an example of the analysis of SF_6 using a highly sensitive Shimadzu Tracera gas chromatograph equipped with a BID.

*1 Helium and neon cannot be detected.

Analysis Results

SF_6 is a powerful greenhouse effect gas, so its release into the atmosphere needs to be prevented. For this reason, there are many instances when SF_6 needs to be analyzed, such as when testing for leaks of the insulation gas contained in electrical equipment, or when testing for trace amounts of residual SF_6 after a gas recovery procedure. The following shows the results of the analysis of atmospheric SF_6 using a BID.
0.1 ppm of SF_6 could be detected (S/N=24*2) and good linearity was obtained within the range from 0.1 to 50 ppm.

*2 Noise was calculated from the baseline of 0.5 to 1.5 min.

Table 1: Analysis Conditions (Analysis of Trace Amounts of SF_6 in Atmosphere)

Model:	Tracera (GC-2010 Plus + BID-2010 Plus) + SPLITTER INJ	Inj. Temp.:	150 °C
Column:	Rt-Msieve 5A (0.53 mm I.D. × 30 m, d.f.50 μm)	Det. Temp.:	280 °C
Column Temp.:	35 °C (2.5 min) – 20 °C /min – 250 °C (0 min) – 15 °C /min – 270 °C (3.42 min)	Inj. Method:	Split (1:7)
Carrier gas:	He, 45 cm/sec (Constant Linear Velocity Mode)	Inj. Volume:	3 mL (MGS-2010)

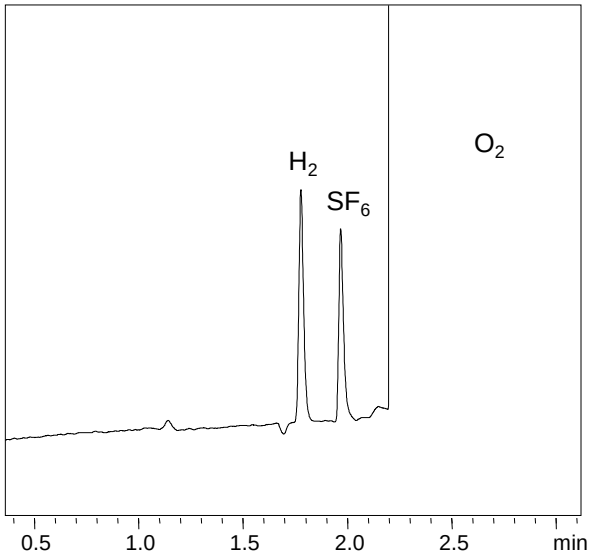


Fig. 1: Chromatogram of Trace Amounts of SF_6 (0.1 ppm) in Atmosphere

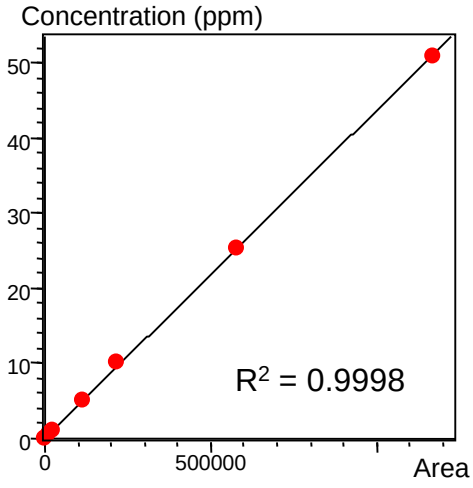
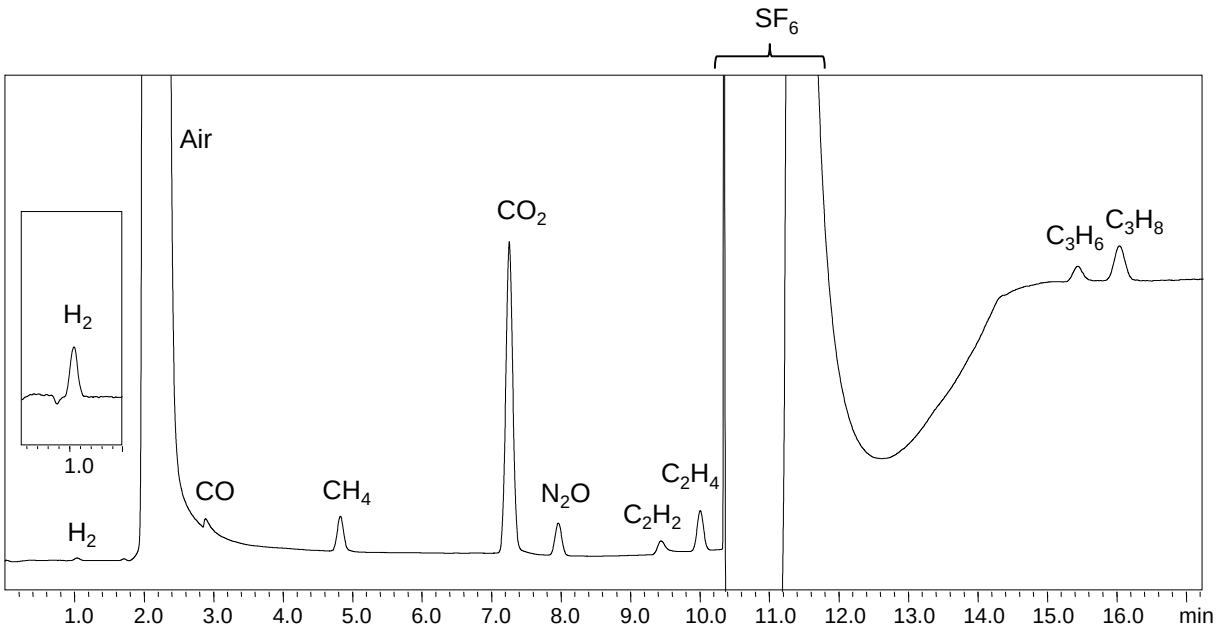


Fig. 2: Linearity of SF_6 in Atmosphere (0.1 to 50 ppm)

SF_6 is used as the insulation gas in a variety of electrical equipment. For this reason, determination of its purity is demanded for quality control purposes to ensure it maintains its insulation capabilities, or during the recovery process. The results of the analysis of impurities in SF_6 using BID is shown in the following.
Even though SF_6, the primary component, was at saturation status, it was possible to perform a highly sensitive simultaneous analysis of impurities, including inorganic gases and lower hydrocarbons, without producing a negative impact on the quantitation accuracy relative to surrounding components.

Table 2: Analysis Conditions (Analysis of Impurities in SF_6)

Model:	Tracera (GC-2010 Plus + BID-2010 Plus) + SPLITTER INJ	Inj. Temp.:	150 °C
Column:	Micropacked ST(1 mm I.D. × 2 m)*3	Det. Temp.:	280 °C
Column Temp.:	35 °C (2.5 min) - 20 °C /min - 250 °C (0 min) - 15 °C /min - 265 °C (3 min)	Inj. Method:	Split (1:4)
Carrier gas:	He, 226.8 kPa (2.5 min) – 15 kPa/min – 400 kPa (3.2 min) (Pressure Mode)	Inj. Volume:	3 mL (MGS-2010)



Concentrations of Impurity Components

H_2: 0.9 ppm	CH_4: 1.7 ppm	C_2H_2: 2.4 ppm	C_3H_8: 1.0 ppm
Air: 11460 ppm	CO_2: 21 ppm	C_2H_4: 1.4 ppm	
CO: 0.9 ppm	N_2O: 2.0 ppm	C_3H_6: 1.0 ppm	

*3 With conditions using this column, there is an overlap of ethane (C_2H_6) with SF_6

Fig. 3: Chromatogram Resulting from the Analysis of Impurities in SF_6

Instruments Used

Gas Chromatograph	Tracera (GC-2010 Plus + BID-2010 Plus)
Injection Port Unit	SPLITTER INJ*4
Gas Sampler	MGS-2010
Software	LabSolutions LC/GC

*4 This unit is specialized for the analysis of trace components in gas, while preventing the intrusion of atmospheric components.

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