Application Note

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Analysis of Parts Per Million-Level Acetylene in Ethylene Using the Agilent 990 Micro GC

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Abstract

The Agilent 990 Micro GC equipped with a 10 m Agilent J&W CP-Al_2O_3/KCl GC column separates 5 parts per million (ppm) acetylene from ethylene with a peak area relative standard deviation (RSD) of 2.43%, a retention time (RT) RSD of 0.149%, and a lower detection limit (LDL) of 0.286 ppm. This makes it an excellent platform for the detection of ppm-level acetylene in ethylene.

Introduction

Ethylene (C_2H_4) is one of the most essential raw chemicals in the petrochemical industry. The production of ethylene is mainly through the cracking of hydrocarbons. In this process, acetylene (C_2H_2) is one of the by-products. Usually, the amount of acetylene should be monitored and reduced to avoid the negative effects in the downstream processes. For example, in ethylene polymerization, the coexistence of acetylene in ethylene results in catalyst poisoning, which affects the quality of the polyethylene. Therefore, analysis of acetylene in ethylene is critical during ethylene production.[1,2]

The 990 Micro GC can quickly and continuously detect trace amounts of analytes. Using the 10 m CP-Al_2O_3/KCl column, ppm-levels of acetylene can be well separated from the ethylene matrix in 1.5 minutes with good repeatability using the 990 Micro GC. This makes it an excellent platform for this application.

Experimental

The Agilent 990 Micro GC was equipped with a 10 m Agilent J&W CP-Al_2O_3/KCl GC column. Table 1 shows the instrumental conditions. Table 2 shows the composition of the standard sample gas. The standard gas was purchased from Air Liquide.

Table 1. Test conditions for the acetylene analysis.

Parameter	Value
Column Type	10 m Agilent J&W CP-Al_2O_3/KCl
Carrier Gas	Helium
Column Pressure	150 kPa
Injector Temperature	50 °C
Column Temperature	50 °C
Injection Time	60 ms
Sample Time	30 s
Run Time	90 s

Table 2. Composition of the standard sample gas.

Compound	Concentration
Acetylene	5.2 ppm
Ethylene	Balance

Results and discussion

The 10 m Agilent J&W CP-Al_2O_3/KCl GC column was equipped to separate ppm-level acetylene from the ethylene matrix. Figure 1 shows the chromatogram of this channel. Five ppm acetylene was well separated from the ethylene matrix peak and has a signal-to-noise ratio (S/N) of 26.2, allowing accurate quantitative analysis. The run time is within 1.5 minutes.

The experimental data are listed in Table 3. Repeatability for RT and peak area was measured as the percentage of the RSD compared to the mean of 20 consecutive runs. The LDL was calculated as two times the 4σ noise.

Table 3. RT, peak area, repeatability, and LDL of 5 ppm acetylene in ethylene.

Compound	RT (min)	RT RSD	Area (mV × s)	Area RSD	LDL (ppm)
Acetylene	0.941	0.149%	0.0138	2.43%	0.286

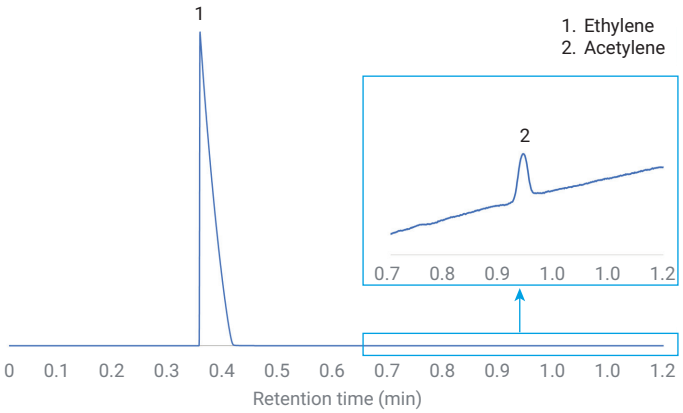

Figure 1. Chromatogram of 5 ppm acetylene in ethylene on the 10 m Agilent J&W CP-Al_2O_3/KCl channel.

Conclusion

The Agilent 990 Micro GC equipped with a 10 m Agilent J&W CP-Al_2O_3/KCl GC column was used for the analysis of 5 ppm acetylene in the ethylene matrix. The acetylene peak was well separated from the ethylene in 1.5 minutes with good LDL and repeatability, making the Agilent 990 Micro GC an ideal platform for the detection of ppm-level acetylene in ethylene.

References

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2. Hu, T. *et al.* Microporous Metal–Organic Framework with Dual Functionalities for Highly Efficient Removal of Acetylene from Ethylene/Acetylene Mixtures, *Nature Communications* **2015**, *6*, 7328.

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