

APPLICATION NOTE

Rapid On-Site Analysis of Tetrahydrothiophene (THT) in Natural Gas Using the INFICON 3000 Micro GC

INTRODUCTION

The abundance and high energy content of natural gas makes it a desirable energy source when compared to petroleum on a worldwide basis. Natural gas is used as a household heating source and is becoming popular for public transportation and as a hydrocarbon feedstock to substitute oil. Since natural gas is odorless and colorless, an odorant is added to detect leaks which could result in gas explosions, leading to property damage and personal injury. Humans are sensitive to odors, so natural gas organizations have recognized odorants as an effective way of detecting natural gas leaks.

Tetrahydrothiophene (THT) is a commonly used odorant additive to natural gas in Europe and Asia to assist in preventing catastrophes. However, THT is not cost effective and may have detrimental effects on the environment if used excessively. It is therefore necessary for natural gas operators to monitor the amount of THT used. Regulatory organizations have established odorization limits to ensure that a minimum amount of THT is present in natural gas, such that it is detectable by a person with a normal sense of smell. For European countries, the THT limits are documented in Marcogas GI-OD-04-01 and can range from 10 to 40 mg/m³ (2.5 to 10.2 ppm). In China, the THT limit is around 20 mg/m³ (5.56 ppm) as documented in CJJ/T 148-2010.

EXPERIMENTAL

A 1-Channel transportable 3000 Micro GC was configured as follows:

- 4 m OV-1701 capillary column
- Large variable volume injector (LVI)
- Thermal conductivity detector (TCD)
- Internal battery and carrier gas cylinder

The experiment was conducted in close partnership with Shanghai Fiorentini. The 3000 Micro GC was calibrated using a 25 mg/m³ (6.95 ppm) THT in methane calibration gas standard. The instrument was then taken to a pipeline natural gas sampling point to analyze an unknown amount of THT using the same analytical method.

RESULTS

Table 1 shows the concentration information for the calibration gas standard and the pipeline natural gas. Figure 1 shows the labeled chromatogram for the 25 mg/m³ (6.95 ppm) THT calibration gas standard. Ten runs were conducted to verify the retention time and peak height repeatability. The percent relative standard deviation (%RSD) values are shown in Table 2. The repeatability was calculated to be 0.03% and 1.63% for retention time and peak height respectively.

Using the calibrated THT method, a pipeline natural gas sample with an unknown amount of THT was analyzed. Five injections were performed to evaluate the instrument repeatability. Figure 2 shows the labeled chromatogram of the pipeline natural gas sample. The THT amount was determined to be 39.2 mg/m³ (10.89 ppm). The %RSD values are shown in Table 3. The repeatability was calculated to be 0.04% and 2.14% for retention time and peak height respectively.

CONCLUSION

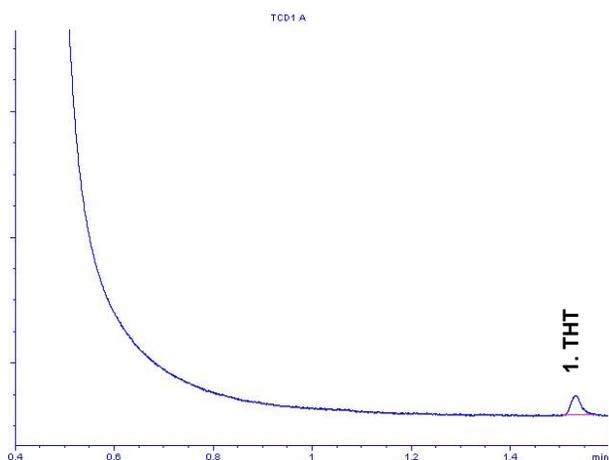
The 3000 Micro GC provides on-site analysis of low level THT in pipeline natural gas in less than two minutes. Because the transportable 3000 Micro GC gives results on the spot, it minimizes loss of sample intensity caused by sample collection and transportation to a laboratory. With an OV-1701 column, the 3000 Micro GC can easily separate THT from neighboring hydrocarbons to provide reliable data to meet THT regulatory needs.

DATA

Table 1 THT concentration information

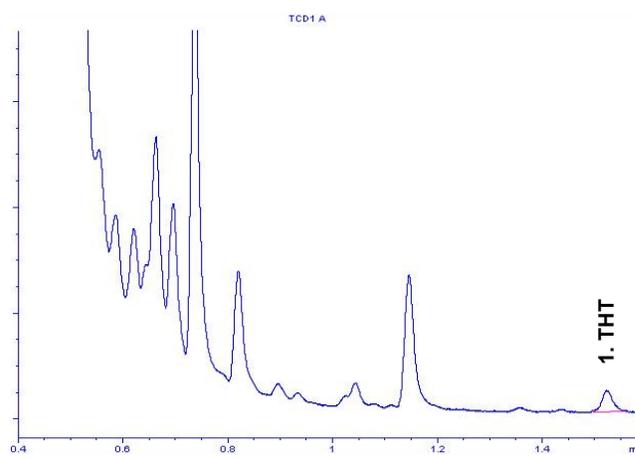
	THT Concentration	Balance
Calibration Gas Standard	25 mg/m ³	Methane
Pipeline Natural Gas	39.2 mg/m ³ (measured)	Natural Gas

Figure 1 Chromatogram of the THT calibration gas standard



Column: OV-1701, 4 m, LVI
 Column Temperature: 87°C, Isothermal
 Column Head Pressure: 40 psi
 Injection Time: 500 ms

Figure 2 Chromatogram of pipeline natural gas with an unknown THT amount



Column: OV-1701, 4 m, LVI
 Column Temperature: 87°C, Isothermal
 Column Head Pressure: 40 psi
 Injection Time: 500 ms

Table 2 Repeatability data for the THT calibration gas standard

Channel	Number of Analyte	Compound	Retention Time (min)	RT %RSD	Peak Height %RSD
A	1	THT	1.53	0.03	1.63

Table 3 Repeatability data for the pipeline natural gas with an unknown THT amount

Channel	Number of Analyte	Compound	Retention Time (min)	RT %RSD	Peak Height %RSD
A	1	THT	1.53	0.04	2.14



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