

Application Note

Rapid Analysis of Natural Gas Composition Using a Single Module Micro GC Fusion

INTRODUCTION Rapid and precise analysis of the chemical composition and physical properties of natural gas is critical for natural gas producers, gatherers, and gas distribution companies for custody transfer. In addition, natural gas engine, boiler, and appliance manufacturers rely on natural gas calculations to determine key development specifications, such as thermal efficiency. Due to the variations in natural gas composition, it is necessary to monitor the physical properties of the gas, such as compressibility, relative density, and heating value (in British thermal units, or BTU). Small differences in heating value can have significant financial impacts. Building on proven microelectromechanical systems (MEMS) technology, Micro GC Fusion is capable of analyzing C1-C8 "plus" (methane through octanes "plus" hydrocarbons and fixed gases present in natural gas) using a single module. The temperature programmable column allows for runs to be conducted quickly, reducing the cycle time of analyses and increasing sample throughput. Temperature programming also allows for rapid column cleaning, which prevents contaminants from remaining in the column and negatively impacting its lifetime.

The web-based Micro GC Fusion user interface combined with Diablo EZReporter automatically calculates chemical composition and physical properties after each sample run. The software generates a standard report using industry specific methods from one of the following standards:

- GPA (Gas Processors Association) 2172, 2145-09
- ASTM (American Society of Testing and Materials) D3588
- ISO (International Standards Organization) 6976

EXPERIMENTAL Ten runs of a natural gas calibration standard were analyzed on a single module Micro GC Fusion containing a 12 meter RT-Q-BOND temperature programmable column. The temperature ramping profile was optimized to elute C1-C8 components within four minutes. Table 1 displays the concentration amounts present in the calibration gas standard.

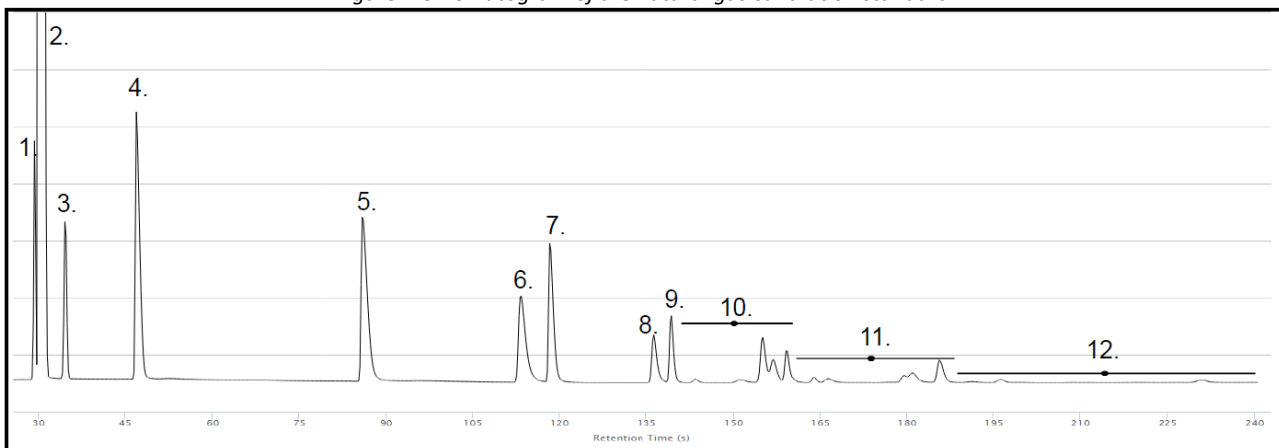
RESULTS With isothermal operation, C4-C8 Plus components do not elute within an acceptable time frame, resulting in carryover. Propane elutes late with a broad peak shape. With temperature programming, the RT-Q-BOND analysis is extended to C8 Plus, providing sharp peaks for all desired components. Within four minutes, all components of interest were resolved and quantified. Figure 1 displays the chromatogram of the natural gas calibration standard. Micro GC Fusion exhibits excellent area repeatability over ten consecutive runs. The area percent relative standard deviation (%RSD) values are listed in Table 2. Figure 2 displays a sample natural gas analysis report from Diablo EZReporter

CONCLUSION Temperature programming permits a single module Micro GC Fusion to reliably analyze natural gas components up to C8 Plus within four minutes. Measurement results are automatically displayed in a tabulated format on the web-based user interface after the analysis is complete. When coupled with the optional Diablo EZReporter software, industry compliant natural gas analysis reports can be automatically generated upon completion of the sample run, providing valuable information for custody transfer situations.

Table 1 Natural gas calibration standard concentration information

Component	Mole %
nitrogen	1.525
methane	88.67
carbon dioxide	1.206
ethane	2.994
propane	2.006
isobutane	1.004
n-butane	0.996
isopentane	0.300
n-pentane	0.300
hexanes	0.603
heptanes	0.320
octanes "plus"	0.075

Figure 1 Chromatogram of the natural gas calibration standard



Column: RT-Q-BOND, 12 m
 Column Temperature: 60°C (hold 50 s) -> 127°C (hold 10 s) -> 220°C (hold 110 s); 2°C/s, 2.5°C/s
 Column Head Pressure: 30 psi



Table 2 Repeatability data for ten runs of the natural gas calibration standard

Number of Component	Component	Retention Time (s)	Area %RSD
1	nitrogen	29.48	0.314
2	methane	30.19	0.359
3	carbon dioxide	34.70	0.414
4	ethane	47.04	0.402
5	propane	86.09	0.660
6	isobutane	113.33	0.426
7	n-butane	118.48	0.454
8	isopentane	136.40	0.449
9	n-pentane	139.37	0.439
10	hexanes	Group Range	0.403
11	heptanes	Group Range	0.827
12	octanes "plus"	Group Range	1.186



Figure 2 Natural gas analysis report using Diablo EZReporter

Natural Gas Analysis Report GPA 2145-09 Analysis

Sample Information

Sample Information	
Sample Name	Natural Gas
Operator	SYSTEM (SYSTEM)
Method Name	Natural Gas 2
Injection Date	2014-11-14 18:11:51
Report Date	2014-12-22 16:00:43
EZReporter Configuration File	Fusion.cfg
NGA Phys. Property Data Source	GPA Standard 2145-09 (FPS)
Data Source	EZIQ data system connection

Component Results

Component Name	Ret. Time	Peak Area	Raw Amount	Norm%	Gross HV (Dry) (BTU / Ideal cu.ft.)	Relative Gas Density (Dry)
Nitrogen	29.478	31421.8	1.5364	1.5326	0.0	0.01482
Methane	30.188	1466302.8	88.8958	88.6723	895.6	0.49116
CO2	34.703	30098.3	1.2117	1.2087	0.0	0.01837
Ethane	47.044	80328.2	3.0003	2.9928	53.0	0.03107
Propane	86.087	71652.8	1.9923	1.9873	50.0	0.03026
isobutane	113.327	43690.5	1.0055	1.0030	32.6	0.02013
n-Butane	118.478	45926.4	0.9964	0.9939	32.4	0.01995
isoPentane	136.398	16672.7	0.2997	0.2990	12.0	0.00745
n-Pentane	139.365	17691.0	0.3004	0.2996	12.0	0.00746
Hexanes	150.000	36660.0	0.6161	0.6145	29.2	0.01828
Heptanes	174.000	20141.0	0.3210	0.3201	17.6	0.01107
Octanes Plus	214.000	3234.0	0.0764	0.0762	4.8	0.00301
Total:			100.2520	100.0000	1139.2	0.67302

Results Summary

Result	Dry
Total Raw Mole% (Dry)	100.2520
Pressure Base (psia)	14.696
Temperature Base	60.0
Gross Heating Value (BTU / Ideal cu.ft.)	1139.2
Gross Heating Value (BTU / Real cu.ft.)	1142.5
Relative Density (G), Real	0.6747
Compressibility (Z) Factor	0.9971
Wobbe Index	1390.9