INFICON

TECHNICAL NOTE

Benefits of Using Temperature Programming on Micro GC Fusion®

INTRODUCTION

A Micro GC provides fast analysis of gas mixtures by analyzing samples in parallel using multiple GC modules. Traditional Micro GCs operate isothermally, which is sufficient for fast analysis of fixed gases and light hydrocarbons. Micro GC Fusion, the next generation Micro GC, is capable of both isothermal and temperature programmable operation.

Isothermal operation maintains a consistent column temperature during the entire analysis. This has several disadvantages, particularly when heavy (C4 and above) components are present in the gas sample.

The disadvantages include:

- Broad peaks for later eluting components
- Carryover effect from heavier components
- Longer run times when compared to temperature ramping
- Lower sample throughput

Temperature programming allows adjustment of the temperature profile and ramp rate during the run. The temperature profile of each module is optimized to elute the desired components quickly. Cool down time is optimized in Micro GC Fusion to provide quick cycle times, often under two minutes.

Advantages of temperature programming include:

- Sharper peaks for later eluting components
- Extended application range on a single column
- Less carryover
- Higher sample throughput

EXPERIMENTAL

In experiment 1, a natural gas calibration standard is analyzed isothermally on an 8 m Rt-Q-Bond column. In experiment 2, a natural gas calibration standard is analyzed on the same 8 m Rt-Q-Bond column using a temperature programmed method. The concentrations of the components are shown in Table 1.

RESULTS

When used isothermally, the Rt-Q-Bond column is limited to methane through propane analysis. (See Figure 1.) Heavier components will stick to the column, and an additional two to three minutes of run time is required to clear these components from the column.

The temperature programmed run extends the application range of the Rt-Q-Bond column, providing analysis of heavier components, such as C4–C8 "plus." These heavier components elute during the course of the run, reducing carryover. (See Figure 2.)

A sharper peak shape, a benefit of temperature programming, is demonstrated by comparing the retention time and shape of the propane peak in both experiments. Using isothermal operation, propane elutes at 161 seconds, compared to 49.4 seconds using temperature programming. By eluting propane faster, the peak shape becomes sharper, providing a more accurate integration. Table 2 contains a list of component retention times.

CONCLUSION

Temperature programming on Micro GC Fusion provides numerous advantages when compared to isothermal operation. More components can be analyzed on a single column, with improved peak shape and sample throughput.

DATA

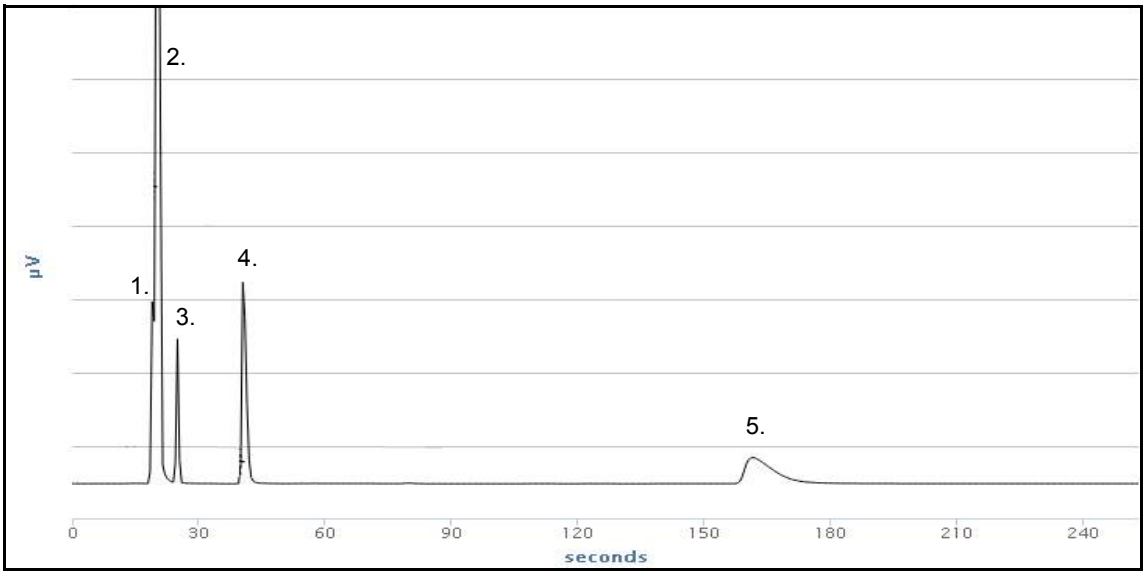
Table 1 Natural gas calibration standard concentration information

Component	Mole %
nitrogen	1.53
methane	88.7
carbon dioxide	1.21
ethane	2.99
propane	2.01
isobutane	1.00
n-butane	0.996
isopentane	0.300
n-pentane	0.300
hexanes	0.603
heptanes	0.320
octanes "plus"	0.0750

Table 2 Retention time comparison for the natural gas calibration standard

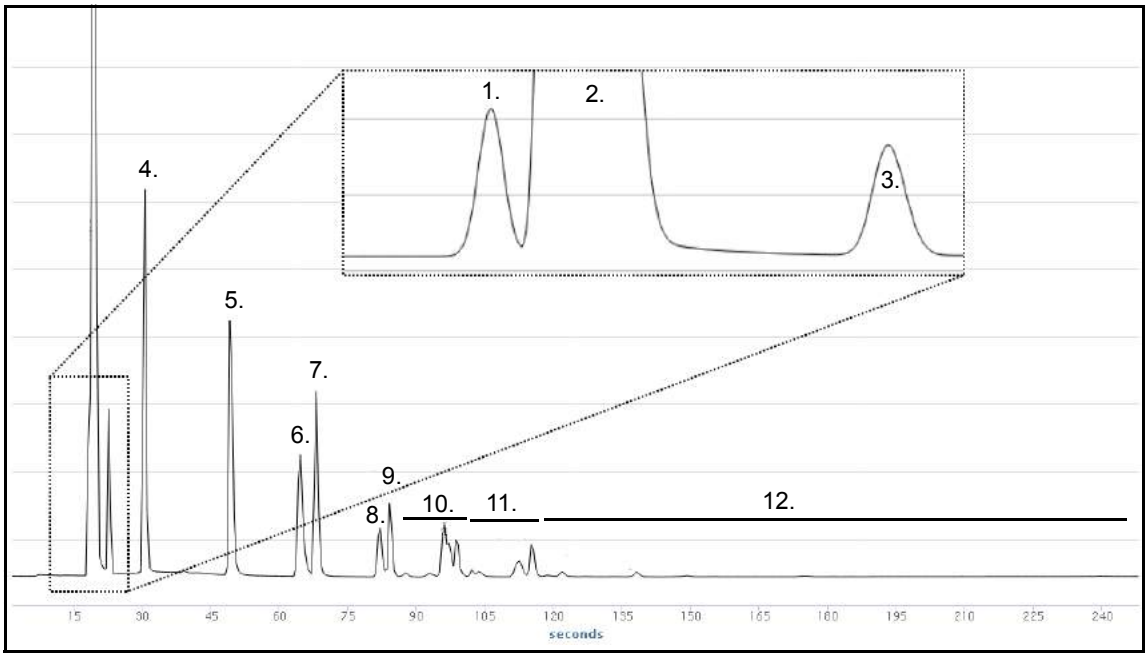
Number of Component	Name of Component	Retention Time (s) Isothermal	Retention Time (s) Temperature Programmed
1.	nitrogen	19.2	18.5
2.	methane	20.5	19.5
3.	carbon dioxide	25.2	22.9
4.	ethane	40.8	30.6
5.	propane	161	49.4
6.	isobutane	N/A	64.7
7.	n-butane	N/A	68.2
8.	isopentane	N/A	82.1
9.	n-pentane	N/A	84.4
10.	hexanes	N/A	86.0 to 100
11.	heptanes	N/A	101 to 119
12.	octanes "plus"	N/A	120 to 240

Figure 1 Chromatogram of the natural gas calibration standard—isothermal



Column: Rt-Q-Bond, 8 m, Variable Volume Injector
Column Temperature: 50°C, isothermal
Column Head Pressure: 20 psi

Figure 2 Chromatogram of the natural gas calibration standard—temperature programmed



Column: Rt-Q-Bond, 8 m, Variable Volume Injector
Column Temperature: 50°C (10 s)→90°C (0 s)→240°C,
Ramp Rate: 2°C/s, 2.2°C/s
Column Head Pressure: 20 psi

INFICON Bring the Lab to the Sample™

www.inficon.com reachus@inficon.com