INFICON

APPLICATION NOTE

# Rapid Analysis of Natural Gas Derived Syngas Using the INFICON 3000 Micro GC

## INTRODUCTION

In 2010, the World Bank estimated that 134 billion cubic meters of natural gas was flared worldwide. Flaring burns surplus gas and is wasteful and detrimental to the environment, producing harmful greenhouse gases. An alternative to flaring is to convert the associated natural gas into synthesis gas (syngas), an intermediate gas used to produce synthetic liquid fuels. Companies like Velocys, Inc. are converting natural Gas-to-Liquids (GTL) using the Fischer-Tropsch (FT) process to present an economical and greener solution to flaring.

The associated natural gas goes through steam methane reforming (SMR), in which the methane gas is passed over a catalyst to generate carbon monoxide (CO), and hydrogen ($H_2$) from methane ($CH_4$).

$CH_4 + H_2O$ --> $CO + 3\ H_2$

Water is removed and the syngas is then cooled down and analyzed to determine the quantity of $H_2$ and CO converted from $CH_4$. The syngas undergoes a conversion via the FT process to convert the $H_2$ and CO to higher hydrocarbon liquid products, such as synthetic crude oil, diesel, or jet fuel.

A 2-channel 3000 Micro GC is capable of analyzing syngas to determine the quantity of $H_2$ and CO converted from $CH_4$. Synthetic fuel producers use this data to maximize their productivity and generate a high quality product. The 3000 Micro GC can also be used to analyze potential contaminants such as ethylene ($C_2H_4$) and ethane ($C_2H_6$).

## EXPERIMENTAL

A calibration gas standard with syngas components was analyzed on a 2-channel 3000 Micro GC containing a Molsieve 5A column with a backflush injector and a Plot Q column with a fixed volume injector. The backflush injector prevents contaminants from entering the Molsieve column. The fixed volume injector provides exceptional precision for the Plot Q column.

The calibration gas was provided by Velocys, Inc. Table 1 displays the component concentrations for the syngas calibration gas standard. The calibration gas was introduced to the 3000 Micro GC through a pressure reducer and Genie® filter assembly to regulate the pressure and remove any particulates.

## RESULTS

All of the key components of the syngas calibration gas were fully separated within 100 seconds. Figure 1 and Figure 2 show the labeled chromatograms from both columns. The 3000 Micro GC has excellent retention time and area repeatability producing percent relative standard deviation (%RSD) values under 0.52% for 10 consecutive runs. The retention time and area %RSD values are shown in Table 2.

## CONCLUSION

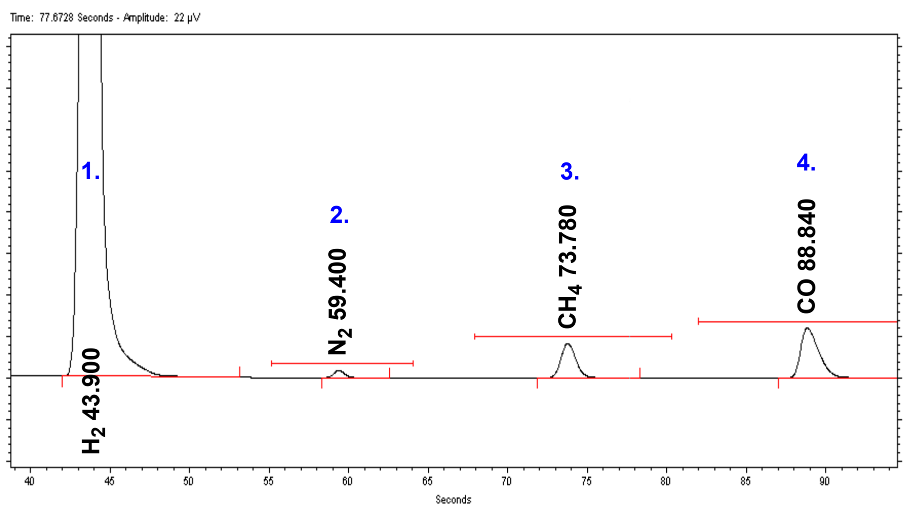
With its speed and precision, the 3000 Micro GC is the ideal instrument to analyze syngas components. Key components, such as $H_2$ and CO, can be separated on two channels in under 100 seconds with excellent retention time and area repeatability.

## DATA

**Table 1 Velocys calibration gas standard information**

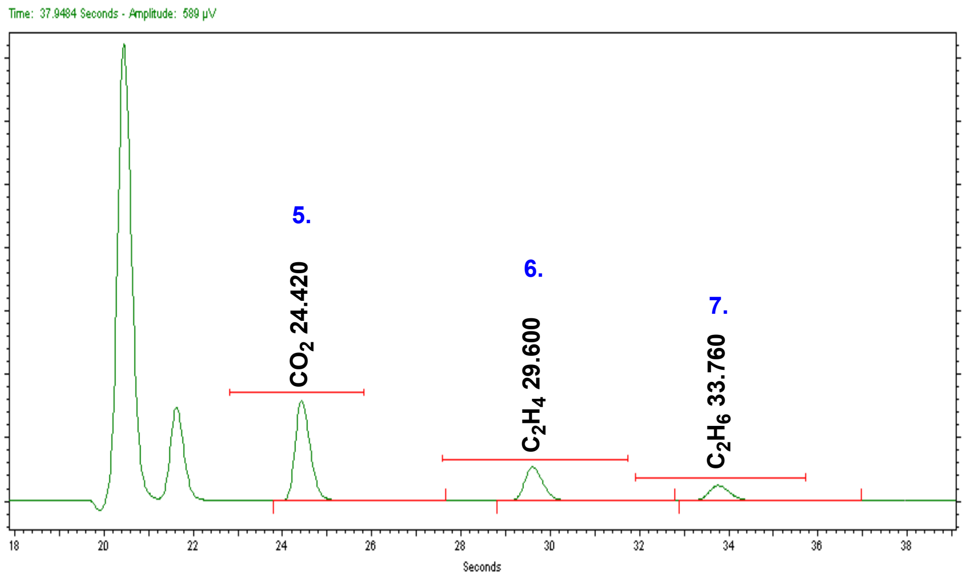
| Component | Mole % |
|---|---|
| $H_2$ | 60.02 |
| $N_2$ | 2.010 |
| $CH_4$ | 5.800 |
| CO | 24.00 |
| $CO_2$ | 5.000 |
| $C_2H_4$ | 2.000 |
| $C_2H_6$ | 1.000 |

**Figure 1 Chromatogram of the Velocys calibration gas standard - Channel A**




*Column*: Molsieve 5A, 10 m, Backflush Injector, 0.32 mm ID, 12 µm df;
*Column Temperature*: 100°C, isothermal; *Column Head Pressure*: 35 psi

**Figure 2  Chromatogram of the Velocys calibration gas standard - Channel B**




*Column*: PLOT-Q, 8 m, Fixed Volume Injector, 32 mm ID, 20 µm df;
*Column Temperature*: 60°C, isothermal; *Column Head Pressure*: 25 psi

**Table 2  Repeatability data for the velocys calibration gas standard**

| Channel | Number of Analyte | Compound | Retention Time (s) | RT %RSD | Area %RSD |
|---|---|---|---|---|---|
| A | 1 | $H_2$ | 43.90 | 0.000 | 0.179 |
| A | 2 | $N_2$ | 59.40 | 0.023 | 0.510 |
| A | 3 | $CH_4$ | 73.78 | 0.015 | 0.245 |
| A | 4 | CO | 88.84 | 0.013 | 0.212 |
| B | 5 | $CO_2$ | 24.42 | 0.035 | 0.033 |
| B | 6 | $C_2H_4$ | 29.60 | 0.032 | 0.063 |
| B | 7 | $C_2H_6$ | 33.76 | 0.019 | 0.084 |

## REFERENCES

1 Tonkovich, A.L.; Jarosch K.; et al; Microchannel Gas-to-Liquids for Monetizing Associated and Stranded Gas Reserves. 2011. http://www.velocys.com/press/wp/wp110206_microchannel_GTL_White_Paper_060211[1].pdf (accessed November 14, 2011)

2 Tonkovich, A.L.;Mazanec, T.; et al; Gas-to-Liquids Conversion of Associated Gas Enabled by Microchannel Technology. 2009. http://www.velocys.com/press/wp/wp091504_%20associated_gas_white_paper_may09.pdf (accessed November 14, 2011)

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