Application Note

Reliable Landfill Wellhead Tuning using Micro GC Fusion®

OVERVIEW This application note describes the advantages of using Micro GC Fusion Gas Analyzer to analyze landfill gas. With its accurate result and simple operation, Micro GC Fusion supports efficient wellhead tuning to optimize landfill gas quality.

INTRODUCTION Landfill gas is mostly generated through the natural decaying process of organic waste in a landfill, which is composed of methane, carbon dioxide, nitrogen, oxygen and other gases. With the high methane concentration in landfill gas, typically ranging 45–60%1, landfill gas is a major contributor to global climate change when allowed to vent freely2. Methane is also known for its high energy content. Capturing landfill gas for energy generation and consumption purposes, therefore, is beneficial for both environmental and commercial purposes.
The United States Environmental Protection Agency (USEPA) Landfill Methane Outreach Program (LMOP) encourages effective use of biogas recovered from landfill emission. Usages may include electricity generation, heating for local communities, and with an upgrade to renewable natural gas (RNG) landfill gas can be used for pipeline injection or vehicle consumption. The United States government facilitates renewable energy adoption by providing regulatory incentives to the energy industry. An example of this is the Renewable Identification Number (RIN)3, a serial number assigned to a batch of biofuel. Compressed or liquefied natural gas produced from RNG generates RINs, which can be purchased by producers and importers of gasoline and diesel to fulfill their Renewable Fuel Standard (RFS) compliance. RIN is therefore a tradable instrument that is highly desirable by petrochemical companies.
A landfill can benefit from outputting high quality landfill gas and selling the gas along with the associated RINS. Efficiency of anaerobic bacterial decomposition of organic waste in a landfill is correlated to the oxygen level in the landfill. To maintain high quality gas output, operators “tune” the landfill by regulating air intake at the landfill wellheads. An important indication of how the wellhead should be tuned is provided by the landfill gas composition at the wellhead. Micro GC Fusion empowers operators with highly accurate and comprehensive gas composition measurement to optimize landfill gas output.

EXPERIMENTAL A landfill gas calibration standard (MESA Specialty Gas) was analyzed on a 2-module Micro GC Fusion:

- Module A: Rt-Molsieve 5A, 10m temperature programmable column with a backflush injector and thermal conductivity detector (TCD)
- Module B: Rt-U-Bond, 12m temperature programmable column with a large variable volume injector and TCD

Two sets of fifteen runs were performed, one set with helium carrier gas and another set with argon carrier gas. The last ten of each fifteen runs were used for the peak area and retention time (RT) repeatability calculation.
An additional run was conducted mixing moisture into the landfill gas calibration standard to simulate composition close to a real landfill gas sample.

RESULTS Six gas components in the landfill calibration standard were analyzed in 90 seconds. See Figure 1, Figure 2 and Figure 3. Relative standard deviation of the last ten consecutive runs were checked. All compounds of interest had peak area %RSD of <1% and a retention time % RSD of <0.1%. The concentrations of the components in the calibration standard, carrier gas used, component retention time, %RSD for peak area and retention time are shown in Table 1

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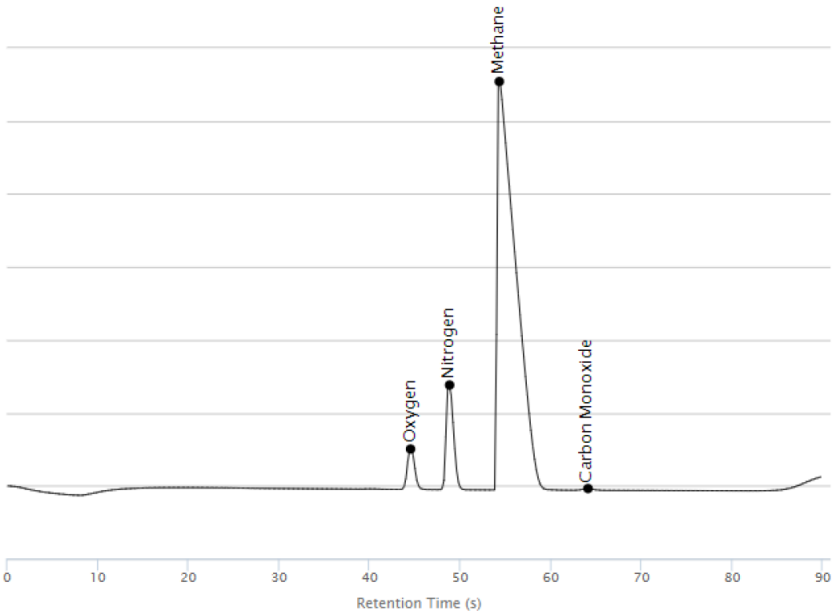
Table 1 Analytical Performance on Landfill Gas Components

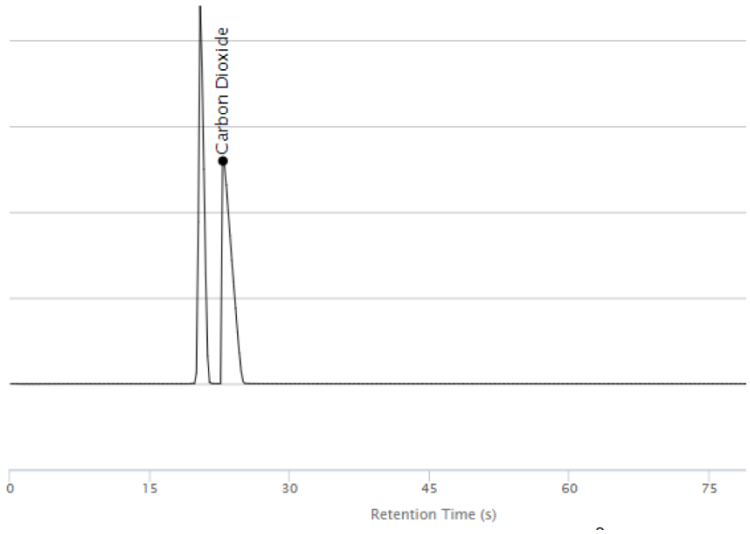
Module	Component	Mole%	Carrier Gas	Retention Time (s)	Area %RSD	RT %RSD
A	hydrogen	5.14	argon	50.08	0.07	0.03
A	oxygen	1.03	helium	44.60	0.36	0.05
A	nitrogen	2.19	helium	48.84	0.28	0.03
A	methane	49.61	helium	54.36	0.61	0.04
A	carbon monoxide	0.10	helium	64.12	0.96	0.04
B	carbon dioxide	41.93	helium	22.96	0.57	<0.01

Figure 1 Chromatogram of Module A (Helium)



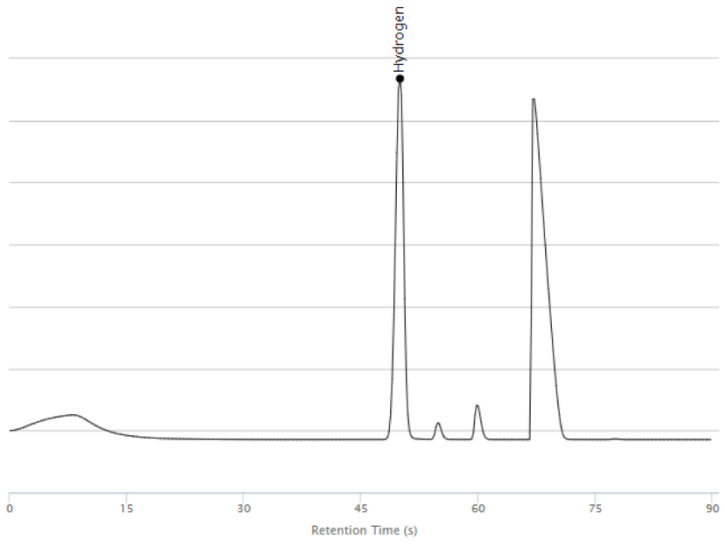
Column: Rt-Molsieve 5A, 10m; Column Temperature: 110°C;
Column Head Pressure: 30 psi; Carrier Gas: Helium

Figure 2 Chromatogram of Module B (Helium)



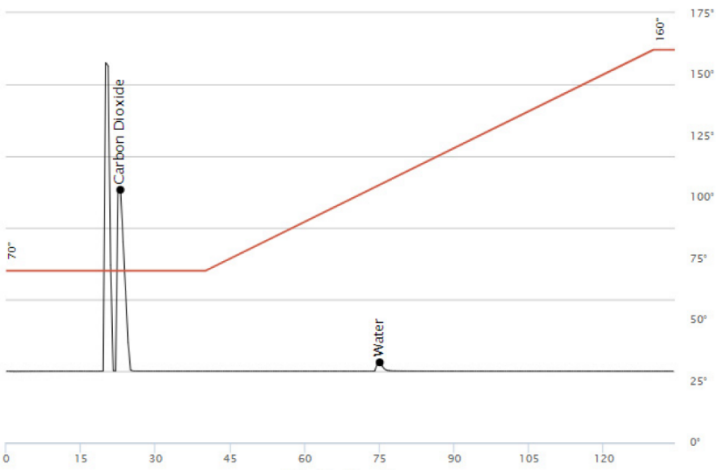
Column: Rt-U-Bond, 12 m; Column Temperature: 70°C; Column Head Pressure: 30 psi; Carrier Gas: Helium

Figure 3 Chromatogram of Module A (Argon)



Column: Rt-Molsieve 5A, 10m; Column Temperature: 110°C; Column Head Pressure: 30 psi; Carrier Gas: Argon

Figure 4 Chromatogram of Module B with Water in Sample (Helium)



Column: Rt-U-Bond, 12m; Column Temperature:
70°C (hold 40 s) to 160°C at 1°C/s (hold 10 s);
Column Head Pressure: 30 psi; Carrier Gas: Helium

DISCUSSION In this experiment hydrogen was detected using argon as the carrier gas. The large difference in thermal conductivity between hydrogen and argon provides the best analytical performance on a TCD. If helium is used as a carrier gas, the hydrogen peak intensity as detected by the TCD will be significantly reduced, due to the small thermal conductivity difference between helium and hydrogen.
Landfill gas usually contains moisture, which elutes on a Rt-U-Bond column after the carbon dioxide peak. The water peak may appear as a ghost peak in the next run if the current run is stopped before water elutes. Starting a temperature ramp after the carbon dioxide peak elutes speeds up the water peak elution. This effectively elimates ghost peak interference in the next run. See Figure 4. A backflush injector is recommended to avoid Molsieve column performance degradation caused by the carbon dioxide and moisture present in landfill gas..

CONCLUSION Micro GC Fusion offers an accurate and simple gas measurement solution for methane, carbon dioxide, nitrogen, oxygen, carbon monoxide and hydrogen. This supports landfill tuning and optimizes landfill gas output quality. With its small size and fast analysis, Micro GC Fusion is the ideal analyzer for both container office or field vehicle setup.