Mud Logging – Rapid Analyses of Well Gases with an Agilent Micro GC

Application Note

Oil and Gas Exploration, Mud Logging

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Abstract

Oil and gas exploration operations require the analysis of dissolved natural gas in samples from the well within short run times. This application note addresses the use of an Agilent Micro GC for rapid, accurate mud logging analysis. Analytical testing of drilling fluid sample using the Agilent Micro GC has proven to be an excellent technique for analyzing individual hydrocarbon gases to assist with lithology reports for the mud logging field. The instrument's small form factor and low consumption of operating gas provides an ideal solution to incorporate into drilling operations.

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Introduction

Mud logging, or hydrocarbon well logging, is the process by which well owners obtain information about the lithology and fluid content of their well. In this process, small pieces of rock or other sediment and the mud that surround it are brought to the surface of a borehole by drilling. The sediment and mud are analyzed to provide a detailed description of the borehole. Hydrocarbon exploration operations requires the determination of natural gas in the well, which is critical information when making decisions on additional drilling or production. Gas detection for this purpose is typically performed in a mobile lab, located near the drill site.

Gas chromatography is proven as an accurate and sensitive technique for separating hydrocarbons and quantifying dissolved natural gas in mud samples. Until now, this application requires a run time of approximately 10 minutes with a bench top chromatograph. However, the compact and portable Agilent Micro GC has dramatically reduced the analysis cycle time to just over 30 seconds. It uses backflush to eliminate residual hydrocarbons, reducing the time between runs even more. It can be used to help calculate hydrocarbon ratios and create lithography reports, identifying individual gases in minimal time.

Experimental

The compounds of interest in the mud logging application include:

- carbon dioxide
- methane
- ethane
- propane
- *i*- and *n*-butane
- *i*- and *n*-pentane

For accurate analysis of methane, this compound should be separated from the permanent gases composite peak.

This method was developed on a dual channel Agilent 490 Micro GC. Each GC channel includes electronic carrier gas control, micro-machined injector, narrow-bore analytical column and micro thermal conductivity detector (µTCD). For this application, the instrument included two PoraPLOT Q column channels equipped with 10 meter and 4 meter columns. Conditions for both channels are listed in Table 1.

Table 1. Instrument Conditions

Instrument	Agilent 490 Micro GC
Channel 1	
Column	Agilent PoraPLOT Q, 10 m
Column temperature	60 °C
Column pressure	240 kPa, helium
Channel 2	
Column	Agilent PoraPLOT Q, 4 m
Column temperature	150 °C
Column pressure	120 kPa, helium

The instrument's low consumption of power and operating gas both contribute to the low cost of operation. Miniaturization has resulted in small, shoe-box size, instrument dimensions that make it easy to integrate into mobile measuring cabinets or explosion proof enclosures. Optional, industry standard 19-inch rack configuration (Figure 1) further simplifies to incorporate the Agilent Micro GC into mud logging operations.

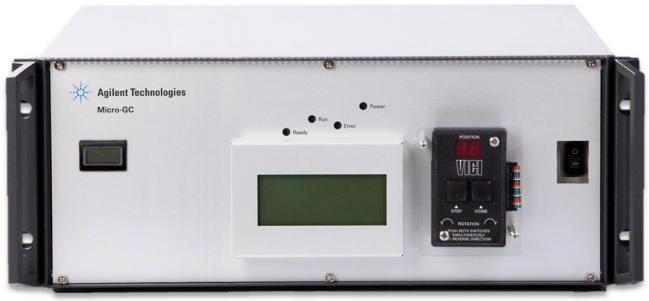

Figure 1. 19-inch rack mounted Agilent 490 Micro GC for smooth process integration.

Prior to analysis by Micro GC, the gases are collected from the drilling fluid typically using semipermeable membranes or vacuum extraction technologies.

The gas sample is injected and analyzed on both analytical channels simultaneously.

Results and Discussion

Channel 1 was equipped with an Agilent PoraPLOT Q , 10-m column and operated at 60 °C. The injectors were heated to ensure that pentane and other possible higher boiling components did not contaminate the injectors. The instrument uses back flush on the first channel, eliminating propane and higher hydrocarbons. This prevents these compounds from interfering in the succeeding analysis and decreases the analysis time.

The isothermal analysis performed with a Micro GC eliminates the need to cool down the column or stabilize the instrument with each run, producing fast run-to-run times. Figure 2 (top) shows the chromatogram of the results from Channel 1 analysis. Methane, ethane and carbon dioxide were separated from the composite air peak and analyzed within 30 seconds, providing close to real-time monitoring. This chromatogram showed good separation and peak shape.

Channel 2 of the Micro GC contained a PoraPLOT Q, 4-m column and was operated at a higher temperature and handled the separation of the higher hydrocarbons. The injector was heated to ensure sharp injection of the sample for pentane and other possible higher contaminants. Propane, butanes, and pentanes were separated easily and eluted in less than 35 seconds (Figure 2 (bottom)). This chromatogram also shows good separation and peak shape.

The detector used with the Agilent Micro GC, a micro thermal conductivity detector, does not require additional operating gases, other than the GC carrier gas. This is in contrast to an FID, which needs make-up and burner gases such as hydrogen and air. As a result, the Micro GC requires very low carrier gas consumption.

All gases of interest were analyzed in a single run, with state-of-the-art communication protocols for easy and automated connection to lithologyy reporting software. Given the Micro GC's small size, it requires low power and is easily integrated into a mobile lab container.

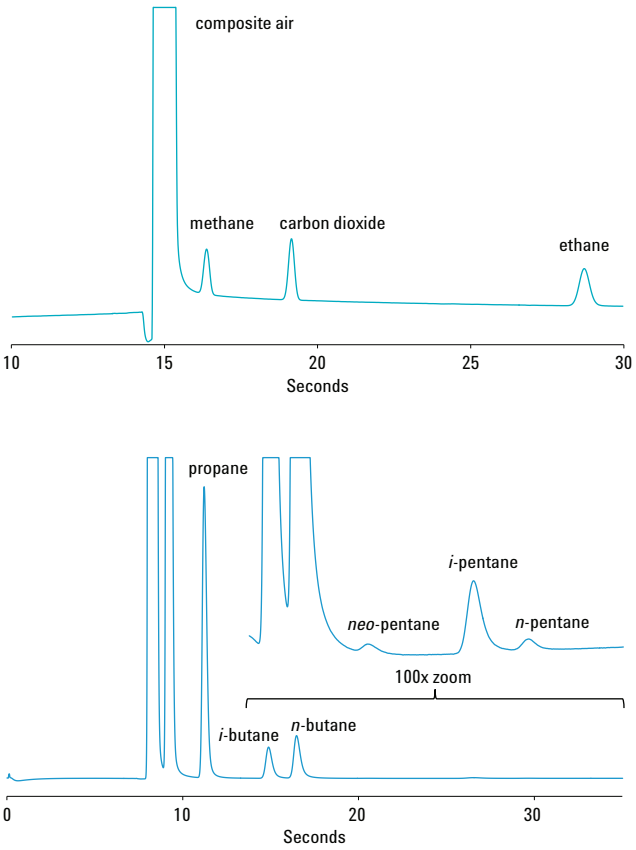

Figure 2. Fast and simultaneous analysis of well gases on two independently controlled column channels.

Conclusion

The Agilent Micro GC equipped with 10 m and 4 m PoraPLOT Q column channels is applicable to the oil and gas exploration industry, which relies upon mud logging to determine prime locations for drilling.

The instrument has been proven to provide rapid, reliable, and consistent results in separating and analyzing hydrocarbons and other gases dissolved in mud samples to use in lithology reports. Isothermal analysis eliminates the need for instrument cooldown and stabilization. The Micro GC analyzes sample composition in just over 30 seconds, resulting in close to real time monitoring.

The instrument's small form factor allows it to be transported easily to an oil rig. In addition, its low consumption of power and operating gases make it an ideal solution to include in on-site control cabins or explosion-proof housings. The industry standard 19-inch rack configuration, available for the Agilent Micro GC, simplifies integration even more.

For More Information

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Printed in the USA
January 29, 2015
5991-2699EN

Agilent Technologies