

Mine Gas Analysis Using the Agilent 490 Micro GC

Application Note

Environmental

Authors

Darren Brady
Safety in Mines Testing and Research
Station (SIMTARS)
Department for Natural Resources
and Mines, Queensland Government,
Australia

Introduction

This note describes the use of the Agilent 490 Micro GC for the analyses of mine gas, and especially carbon monoxide at low level, detection of which is essential for the safety of mine workers. Three independent GC channels analyze the sample in less than two minutes, including permanent gases and C1-C2 hydrocarbons.



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Instrumentation

490 Micro GC

- Channel 1: Agilent J&W CP-Molsieve
- Channel 2: CP-Molsieve
- Channel 3: Agilent J&W PoraPLOT Q

Materials and Methods

The 490 Micro GC analysis uses argon on CP-Molsieve channel 1. This was done to measure hydrogen, helium and all other permanent gases in one channel. Using argon as carrier gas gives an excellent response for hydrogen and helium but a reduced sensitivity for the permanent gases compared to using hydrogen/helium as carrier gas. The limit of quantification (LOQ) is approximately 50 to 100 mg/L for oxygen, nitrogen and CO. Using nitrogen as carrier gas detects no nitrogen, and almost no oxygen or carbon monoxide. Very low concentrations of oxygen and nitrogen (mg/L level) can be measured on the carbon monoxide CP-Molsieve channel 2.

Low carbon monoxide levels were detected on CP-Molsieve channel 2, with no interference from bulk methane. The mixture to test low levels of CO was 2 mg/L CO in methane. To detect low CO in bulk methane two settings are crucial. First, the use of back flush enables the elimination of peak tailing interference of the bulk methane during the elution of CO. Secondly, the detector was set in the extra high sensitivity mode. However, as a result of using this mode, auto ranging of the detector was set off and high concentrations of components could not be measured, since the signal was cut off. CO₂, ethane and ethylene were measured on channel 3 using a PoraPLOT Q column.

Conditions

Table 1. Chromatographic conditions

	Channel 1	Channel 2	Channel 3
	10 m CP-Molsieve	10 m CP-Molsieve	10 m PoraPLOT Q
Injector Temp (°C)	50	50	50
Column Temp (°C)	100	70	70
Carrier Gas	Argon	Helium	Helium
Column Head Pressure, Static (kPa)	150	150	150
Injection Time (ms)	100	100	100
Back Flush Time (s)	Not present	5.65	Not present
Detector Sensitivity	Medium	Extra high	High

Results and Discussion

Separations are shown in the figures, with Figure 1 indicating the effect of using the detector in extra high sensitivity mode. Figure 3 demonstrates the ability of the 490 Micro GC to detect trace levels of carbon monoxide in the presence of bulk methane.

Peak identification	Rt (s)
1. Hydrogen	27
2. Oxygen	37
3. Nitrogen	48
4. Methane	66
5. Carbon monoxide	111
6. Carbon dioxide	24
7. Ethylene	30
8. Ethane	34

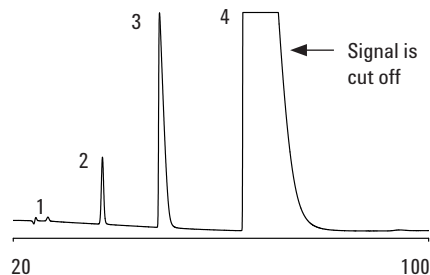


Figure 1. Permanent gases on channel 1

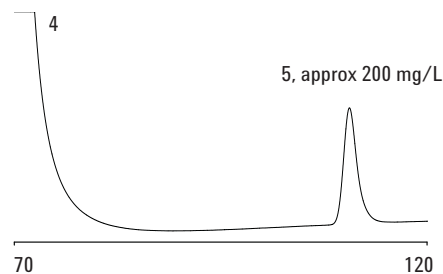


Figure 2. Carbon monoxide on channel 2

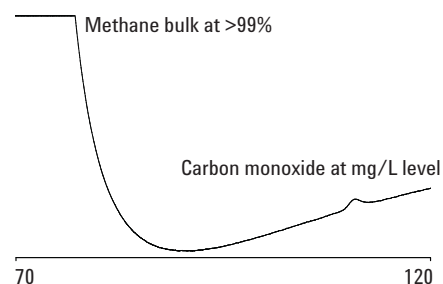


Figure 3. Low mg/L carbon monoxide sample in methane, channel 2

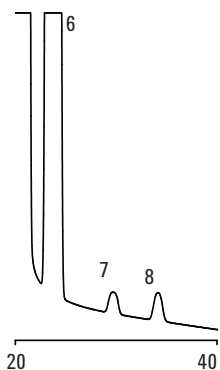


Figure 4. Carbon dioxide, ethane and ethylene on channel 3

Conclusion

The Agilent 490 Micro GC successfully analyzed a sample of mine gas. The excellent performance of the instrument was shown by its capability to detect very low levels of potentially lethal carbon monoxide, even in the presence of bulk methane.

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