PAC | Application Note

AC Hi-speed RGA on 8890GC with built-in 13X column conditioning.

- Hi-speed RGA with optional programmable 13X heater
- Conditioning of 13X column inside system
- Optimum separation for Oxygen, Nitrogen, Methane and CO

Keywords: Hi-speed RGA, Programmable 13X, Oxygen, Nitrogen, Methane, CO

Figure 1: Hi-speed RGA on Agilent 8890 platform

INTRODUCTION

Refinery gas streams (e.g. fuel gas, atmospheric overhead, FCC overhead, coker gas, etc.) vary considerably in composition. Determining individual components of each gas stream is a challenge. An exact measure of stream components is essential in achieving optimum control and assuring product quality. AC Analytical Controls offers the AC Hi-speed Refinery Gas Analyzer, an analyzer that determines and reports the composition of the various refinery gas streams in less than 6 minutes

With the release of the next generation Agilent GC, our Hi-speed gas analysis application has been converted from an Agilent 7890B GC to the new Agilent 8890 GC based configuration. In addition, the AC Hi Speed RGA is now available with a programmable 13X column that can optionally be supplied with the analyzer. This allows for easy conditioning of the 13X column without removing it from the system. Conditioning of the column ensures an optimal separation for Oxygen, Nitrogen, Methane and Carbon monoxide.

SYSTEM DESCRIPTION

The AC Hi-Speed RGA system is based on three analysis channels (using 6 columns in total):

1. The first channel determines Helium and Hydrogen, using TCD for detection (figure 8).
2. The second channel is used to determine Oxygen, Nitrogen, Carbon monoxide and Carbon dioxide, using a second TCD for detection.
3. The third channel separates the Hydrocarbons on the PLOT column using the FID for detection (figure 9).

All three channels are operated simultaneously (but can also work independent), yielding three chromatograms in one combined report in the GasXLNC software.

Some of the analyzer features:

- The micro-packed columns of the two TCD channels are mounted in a separate isothermal column oven in the left-side compartment. This guarantees excellent repeatability for both retention time and areas.
- The sample introduction line is configured with a “sample shut-off” valve that stops the sample flow through the sample loops a few seconds before operating the sample valves. Thus the sample pressure inside the loop at the time of sampling is always back to the ambient pressure to ensure excellent repeatability.
- All tubing used in the system is Sulfinert™ to prevent adsorption of active components and contribute to more accurate results and a higher data reliability.

For this application note we will focus on the 2nd channel TCD channel, which consists of a ten-port valve, a six-port valve, two HayeSep micro-packed columns, and a Molsieve 13X micro-packed column, all mounted in the left side compartment isothermal oven. The carrier gas is Helium and the flows are auxiliary EPC controlled.

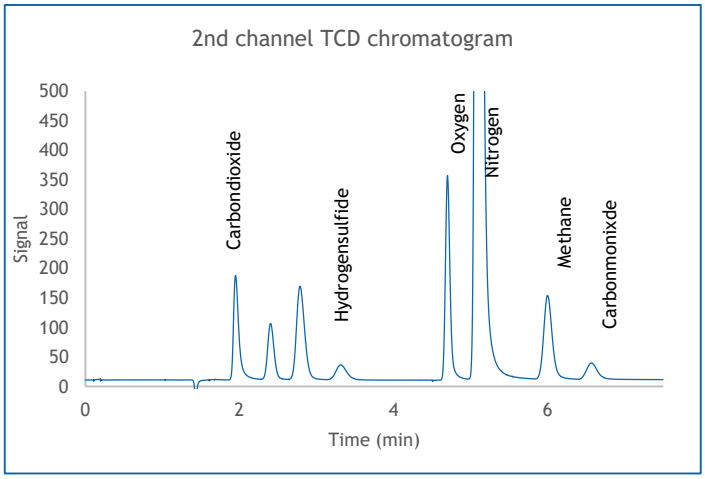

Figure 2: Permanent gases 2nd channel TCD chromatogram

The sample is introduced into the system using a sample loop and transferred to the 1st HayeSep column. Oxygen, Nitrogen, Methane and Carbon monoxide pass both HayeSep columns without much retention and elute onto the Molsieve 13X column. Here these components are trapped by switching a valve that puts the column in a stop flow position. Then the Carbon dioxide and (depending on the method used) C2 Hydrocarbons and Hydrogen sulfide elute from the 1st HayeSep column to the 2nd HayeSep column. Just after the elution of Carbon dioxide or Hydrogen sulfide all remaining components are backflushed from the first column to vent.

Meanwhile, Carbon dioxide and Hydrogen sulfide are separated on the 2nd HayeSep column and detected by the TCD. After the elution of Carbon dioxide or Hydrogen sulfide, the Molsieve 13X column is put back in flow by switching a valve, and the permanent gases are separated and detected by the TCD. See figure 2.

13X COLUMN CONDITIONING

The Molsieve 13X column (figure 3) separates Oxygen, Nitrogen, Methane and Carbon monoxide. After extensive use, the separation on the column may deteriorate (mainly caused by moisture introduced by a wet sample or the carrier gas). The separation between Oxygen and Nitrogen will be degraded, and the Carbon monoxide peak may even coelute with Methane.

The separation performance can be restored by conditioning the column for several hours at 300 °C. However, the column compartment where all micro-packed columns are housed cannot reach that temperature and the 300 °C will affect the performance of the other columns in the oven. Therefore the 13X column should be removed from the system and placed in an external oven for conditioning. This means that additional equipment is needed to condition the column (e.g. an old GC) and that the analyzer can not be used for a significant period.

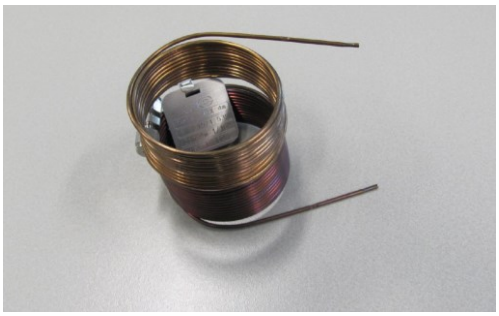

Figure 3: Micro-packed Molsieve 13X

Therefore, AC has developed a special micro-packed column heater (figure 4) that allows to condition the 13X column (figure 5) without having to remove it from the analyzer The implemented heater and temperature sensor provide fully controlled temperature programming for a user defined time. Usually overnight conditioning (4 hours) at 300 ° C is sufficient to restore the full resolution of the 13X column.

Figure 4: Programmable 13X heater

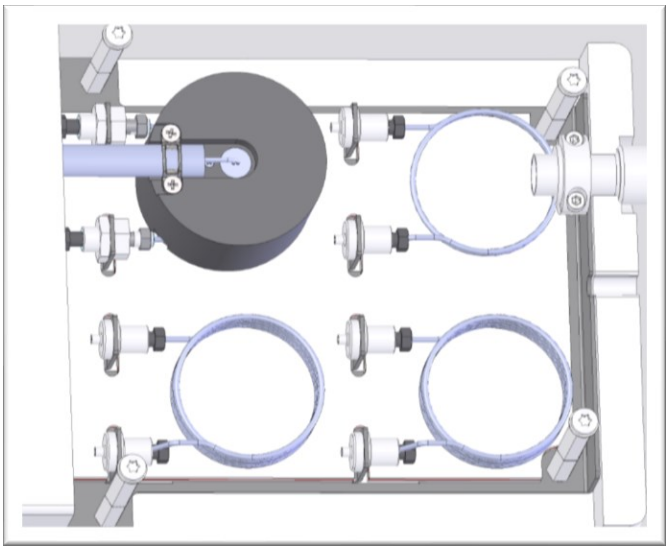

Figure 5: Programmable 13X heater installed inside the column box of Hi-speed RGA (cover removed)

VALIDATION

For validation purposes, a 13X column is "wetted" with a permeation device containing a tube of water. This approached the situation where a 13X column is exposed to a dirty sample or a carrier gas containing fairly large amounts of water. The separation on the 13X fraction was affected; the Oxygen / Nitrogen separation was degraded, but, in particular (the main issue) reduced retention of Carbon monoxide resulted in co-elution with Methane (Figure 6).

The integrated 13X column heater is then programmed at 10 ° C / min to 300 ° C (for 4 hours). After stabilizing to standard operating temperature (70 ° C), a new run with a standard RGA gas was started. The separation of the components in the 13X fraction was fully restored (Figure 7). The other separations were not affected during this entire process.

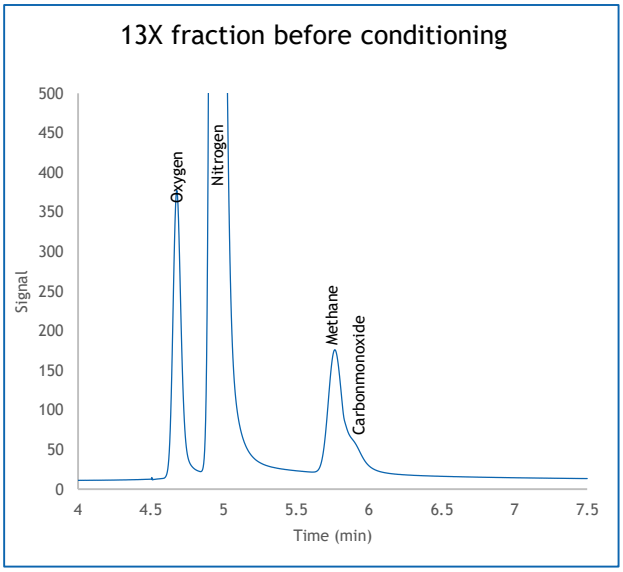

Figure 6: 13X fraction with compromised separation characteristics (before conditioning).

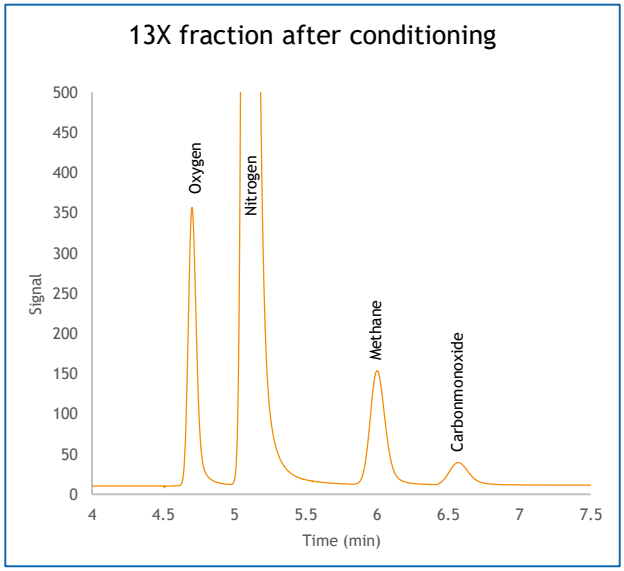

Figure 7: 13X fraction after conditioning inside the system.

CONCLUSION

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AC has introduced in the new 8890-based Hi-speed RGA a programmable built-in 13X column heater. This to overcome the cumbersome and time-consuming procedure of having to take the 13X column for conditioning like in previous generations of RGA's.

The test results demonstrate that this option can bring the 13X column back to its original performance, without having to remove the column from the system and without affecting the rest of the system performance.

This option, along with the other features of the AC Hi-speed RGA, contributes to maximum analyzer up-time and ensures accurate results and high data reliability.

ORDERING

The programmable 13X heater can be ordered as an option for the Hi-speed RGA on 8890 GC using the following part number.

Part number	Descrption
GCG2330.001	Programmable 13X for Hi Speed RGA on 8890

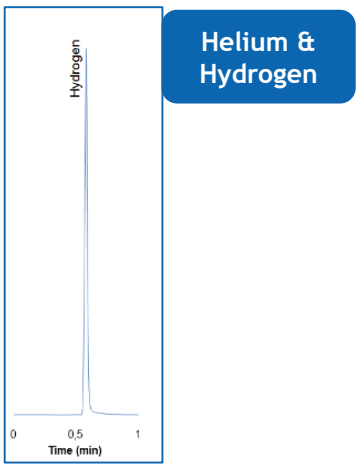

Figure 8: Hydrogen analysis

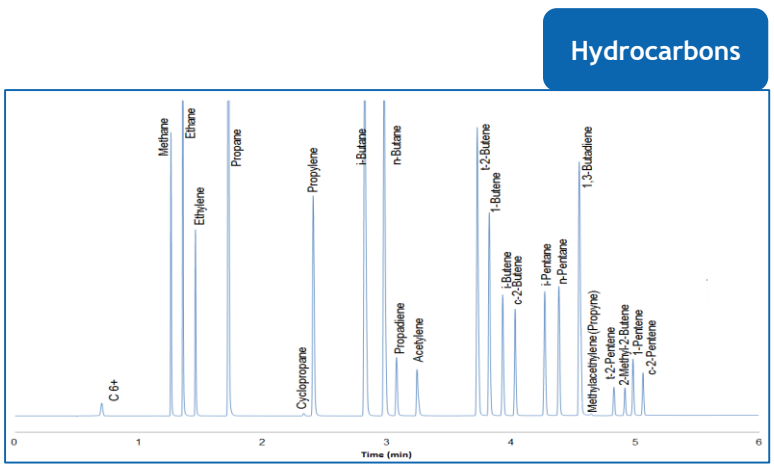

Figure 9: Hydrocarbon analysis

AC Analytical Controls® has been the recognized leader in chromatography analyzers for gas, naphtha and gasoline streams in crude oil refining since 1981. AC also provides technology for residuals analysis for the hydrocarbon processing industry. Applications cover the entire spectrum of petroleum, petrochemical and refinery, gas and natural gas analysis; ACs Turn-Key Application solutions include the AC Reformulyzer® , DHA, SimDis, NGA, Hi-Speed RGA and Customized instruments.