Single Detector Deans Switch Natural Gas Analysis with Resolution of Oxygen and Nitrogen

Application Note

Natural Gas Analyzer

Authors

Kelly Beard and Shannon Coleman

Agilent Technologies, Inc.

USA

Abstract

A gas chromatography method has been developed for the analysis of natural gas and natural gas liquids by capillary column, single valve, single TCD, and a Capillary Flow Technology (CFT) Deans Switch. This application note describes a method for the analysis of nitrogen, oxygen, carbon dioxide, and C1-C6 N-paraffin's from a gas or liquid phase natural gas sample.

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Introduction

Currently, packed columns are extensively used for the analysis of natural gas, and have been for years, however, packed columns are inconsistent and require complex valve systems, creating challenging applications. In addition, much of the phase material is either difficult to obtain, or no longer available. By using capillary columns and CFT technology, a simple, consistent, and robust application is now available for natural gas analyzers. The typical application of the Deans Switch requires the use of two detectors. The example described in this application note shows that as long as sufficient resolution is present, the two exit columns of the Deans Switch can be connected together with a CFT tee, which then flows to a single detector. In this example, we accomplished this with a single detector installed on a Deans Switch, what would normally require two detectors installed on a Deans Switch.

For this natural gas analysis, an Agilent 7890 Gas Chromatograph was fitted with a 6-port gas sample valve, a 4-port liquid sample valve, a split/splitless inlet, a CFT Deans Switch, a PoraPLOT Q column, and a MolSieve column.

Results and Discussion

There are three different ways to introduce samples with this configuration:

- Directly from the gas sample cylinder through a gas sample valve
- Directly from a piston style liquid sample cylinder through a liquid sample valve
- Syringe injection directly into the GC inlet

This configuration allows for simultaneous separation of all components to a single detector, while eliminating the possibility of contamination of the MolSieve column.

Figures 1 and 2 show the results from a typical Deans Switch configuration where the outlet of the Deans Switch flows to separate detectors. As the permanent gas component elutes from the Plot Q column, it is heartcut to the MolSieve column. These gases are then separated on the Molsieve and detected by TCD as seen in Figure 1. After the heart cut is made, the remaining components elute through a restrictor to a second TCD bypassing the MolSieve column, see Figure 2.

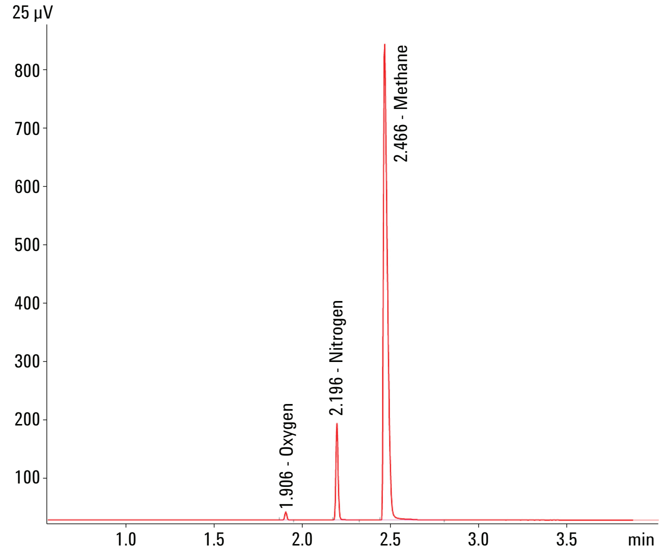

Figure 1. MolSieve TCD channel.

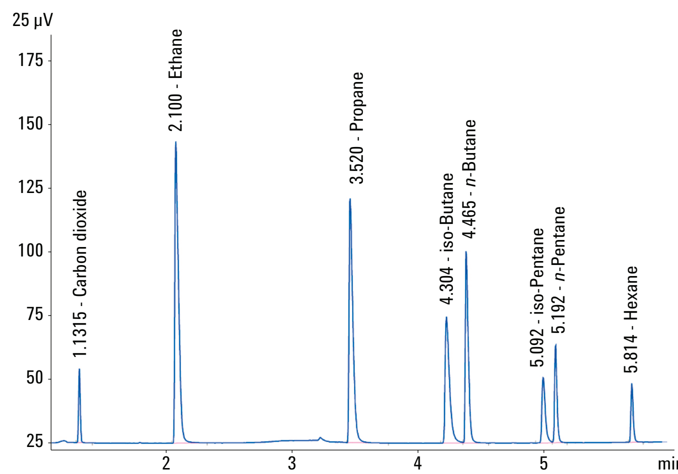

Figure 2. Plot Q Restrictor channel bypassing Molsieve.

Table 1. Standards

Compound	**%**
Oxygen	0.500
Nitrogen	6.00
Carbon Dioxide	1.00
Methane	68.45
Ethane	9.00
Propane	6.10
iso-Butane	3.02
n-Butane	3.00
neo-Pentane	0.500
iso-Pentane	0.710
n-Pentane	0.710
Hexane	0.510
Helium	0.500

Table 2. Gas Chromatograph Conditions and Set Points

GC Run Conditions	
Analytical column	CP7554, CP-PoraPLOT Q, 25 m × 0.53 mm, 20 µm 19095P-MS0E, HP-PLOT MolSieve, 30 m × 0.53 mm, 50 µm 160-2255-30, Deact. Fused Silica Tubing, 30 m, 0.25 mm (cut 1.5 M)
Inlet temperature	250 °C
Inlet pressure	15.706 psi
Carrier gas	Helium, constant flow 10 mL/min
Split ratio	20:1
Oven program	35 °C for 3.0 minutes, then 10 °C/min to 200 °C for 10 minutes
Column velocity	40 cm/sec
Injection	Gas sample valve, 0.25 mL
Valve box temperature	150 °C

Although this is an effective method of analysis, it seems redundant to have two equivalent detectors on a Deans Switch when sufficient resolution is present for the analysis using a single detector. In the example shown in Figure 3, the analysis is accomplished by connecting the outlets of the Deans switch columns to a single detector using a CFT tee. Now all components are resolved on a single detector, using a single Deans Switch system.

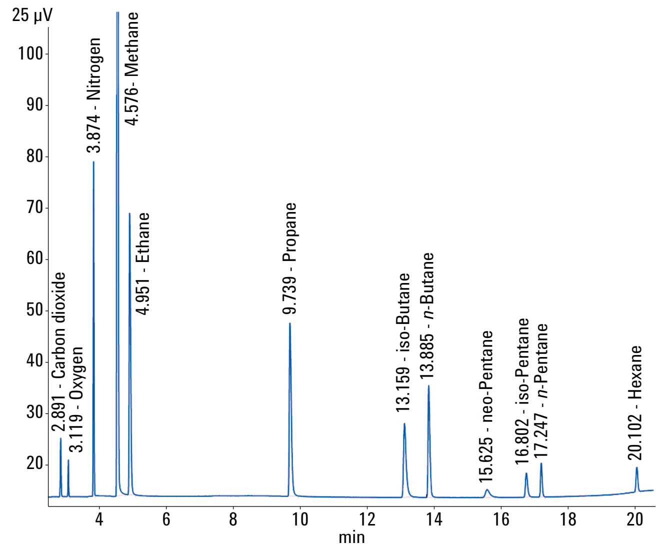

Figure 3. Combined PoraPLOT Q and MolSieve on a single TCD Deans Switch System.

Conclusion

Some Deans Switch analysis may benefit by using a single detector. This is an economical use of a Deans Switch by eliminating a detector. The analysis is also simplified since all components are analyzed by a single detector. This system also provides a more user friendly hardware arrangement requiring less maintenance and setup time when compared to the more expensive valve system to perform an equivalent analysis.

For More Information

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