Introduction

The most common analysis of natural gas is to measure N₂, CO₂, and C1 to C5 hydrocarbons, with back flush of the heavier hydrocarbons as a single C6+ peak. If it should be necessary to measure the O₂ content, a second sample may be injected into a molecular sieve column for separation of O₂ from N₂. An alternative is to use a porous polymer column that is capable of separating these gases at sub-ambient temperatures and that provides the remaining separations with temperature programming.

The British Institute of Petroleum describes this latter approach in its standard method for natural gas analysis IP345. The method described here meets the requirements of this standard.
Results and Discussion

If O₂ and N₂ need to be separated, an initial column temperature of –50 ºC is used. After elution of oxygen, the column temperature is programmed at 15 ºC/min to a maximum of 240 ºC. Switching the valve back to its original position back flushes the column. The user may opt to do this after the elution of pentane, to obtain a C6+ peak, or at any other time during the analysis. If back flushing is delayed, heavier hydrocarbons through about C9 will be eluted with some separation (Figure 2). With back flushing after nC5, the total analysis time is about 27 minutes (Figure 3). If an initial column temperature of 70 ºC is used, O₂ and N₂ are not separated, but are eluted as a single peak, usually referred to as the N₂ peak, separated from methane. The column temperature is then programmed to about 220 ºC to elute the heavier gases with back flushing or not, as desired. The analysis time through C6+ is reduced to about 18 minutes. Since only one carrier gas is needed for this single channel analysis, a second 8-port valve may be installed in the reference channel of the TCD along with a molecular sieve column. This provides a means of separation of O₂ and N₂ without the need for LN₂ or LCO₂. (Note that using a second injection into a molecular sieve does not conform to IP345.)

Instrumentation

We used an Agilent GC with LN₂ or LCO₂ sub-ambient column oven capability, an 8-port valve, TCD and FID in series, and a 12 ft x 1/8 in, stainless-steel column packed with HayeSep R. IP345 specifies Porapak R, but HayeSep R is chromatographically identical and causes less baseline drift on temperature programming. Data handling was carried out using Agilent chromatography software.

The functions of gas sample injection and column back flush to detector were combined in the 8-port valve (Figure 1). Elemental and inorganic gases were measured with the TCD. The optional FID (required for IP345) may be used for better detection of hydrocarbons. A common procedure is to use the TCD for all components through ethane or propane, followed by the FID for C4 and heavier hydrocarbons.
Conclusions

The Agilent GC system can be configured to use a single column for economical analysis of natural gas to IP345, with Agilent chromatography software for effective data handling.

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