Analysis of Natural Gas and Natural Gas Liquids by Gas Chromatography

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Introduction
Natural gas analyses are performed routinely by a number of companies large and small. Since profits are a main concern, quality of analysis, short analysis times and ease of reporting are major considerations when deciding what type of instrument to purchase.

The TRACE™ GC, in conjunction with the ChromQuest® data system, is easily configured to perform the various Gas Processors Association (GPA) methods and others for the analysis of natural gas and natural gas liquids. Analysis to determine Btu content as described in GPA 2261 and extended analyses of rich gas systems and situations, GPA 2286, where the C6+ compositional breakdown is desired, may be accomplished with a single system. Both analyses may be performed simultaneously or individually. Many companies performing these analyses are using conventional integrators to collect the raw data. The raw data is then manually entered into a customized software package which is used to generate a report in a format presentable to the client. Manual entry of raw data into custom software packages requires additional labor. The Finnigan ChromQuest data station offers a variety of data export options enabling an automatic raw data transfer to custom software packages, thus minimizing the time required to customize these reports.

Experimental
The analytical system in Figure 1 provides the necessary components to determine the chemical composition of natural gas and similar gaseous mixtures and to perform both Btu and/or extended analyses for calculation of gross heating values. A side-mounted valve oven houses all valves and pneumatics for both liquid and gas sampling. Btu analysis is performed at an isothermal temperature and the extended analysis is performed using a temperature program. These simultaneous analyses require that the columns be heated separately. In the TRACE, the valve oven accommodates the columns required for isothermal analysis, Figure 2, and the column oven houses the capillary column used for extended analysis, Figure 3. A detailed plumbing diagram is shown in Figure 4.

Btu Analyses
Gross heating values are calculated based on the separation of the various components in natural gas and calculation of Mol%. A fixed sample volume of either a gas or liquid is injected for analysis using Valve 5 or Valve 2. The liquid or gas injection enters the 30” DC 200/500 pre-column which is in series with a 30’ DC 200/500 analytical column.

The pre-column will retain hydrocarbons C6+ and pass the lighter components onto the analytical column. After 1.45 minutes Valve 3 is actuated allowing the pre-column to backflush into the TCD, while the components from the analytical column, properly separated, re-enter the pre-column and pass through to the TCD as well.

Figure 1. TRACE Gas Chromatograph
A custom report showing a typical chromatogram and a Mol% results table appears in Figure 5.
Instrument Conditions

**TRACE GC**
Right injector temp (located on valve oven): 120°C

**TCD/Valve Oven**
Detector temp. 200°C
Valve oven temperature: 160°C
Valve oven column flow 26 mL/minute helium using a 0-60 mL/min flow controller (col. head-pressure 54 psig)
Reference flow: 26 mL/min.
Inject @ 0.01 min, Valve 2 and backflush @ 1.42 min, Valve 3.

**FID/GC Column oven**
35°C, 4 min; 7.5°C/min, 160°C, 0 min;
10°C/min; 200°C, 5.34 min
Run time: 30 min
Column flow 1.8 mL/min Helium
FID temp 275°C
H2: 35 mL/min
Air: 350 mL/min
Makeup: 30 mL/min N2
Inject @ 0.01 min Valve 1

**Data Collection**
ChromQuest data station: 0-10 Volt

**Extended Analyses**
Analysis of natural gas and liquid natural gas to provide identification of hydro-carbon components C6+ is accomplished using a single capillary column and an FID.
Valve 4 and Valve 1 are used to make a liquid or gas injections respectively. Injection is made onto a 60 M SPB-1 x .32 mm id. x 1.00 µm capillary column (or equivalent). Peak identification starts with 2,2-dimethyl-Butane. Benzene, n-Heptane, Toluene, and n-Nonane were selected as time reference peaks.

A ChromQuest custom report (Figure 6) offers a printed chromatogram with peak identification and raw data report. These data are available for export in a variety of formats to accommodate individual user programs.

**GC Control**
Full GC control is accomplished through ChromQuest. All oven program parameters, detector parameters and optional injector pressure program parameters can be set for the selected GC. Custom labeling of timed events for control of air-actuated valves enables the operator to quickly identify and program valve switching, as shown in Figure 7.
Results
Simultaneous analysis offering Btu and extended results were performed in less than 30 minutes. Btu analysis only may be performed in less than 15 minutes. The retention time reproducibility of the GC in conjunction with the peak naming function of the ChromQuest data station allow easy identification of the complex mix of the individual compounds found in the extended analysis.

Conclusion
The analysis of natural gas and natural gas liquids for Btu content and extended hydrocarbon detail may be accomplished using a valved GC with two independently heated ovens. The ChromQuest data system demonstrates the powerful benefits of the PC in producing accurate custom reports. The automatic export function permits rapid production of user-preferred reporting.