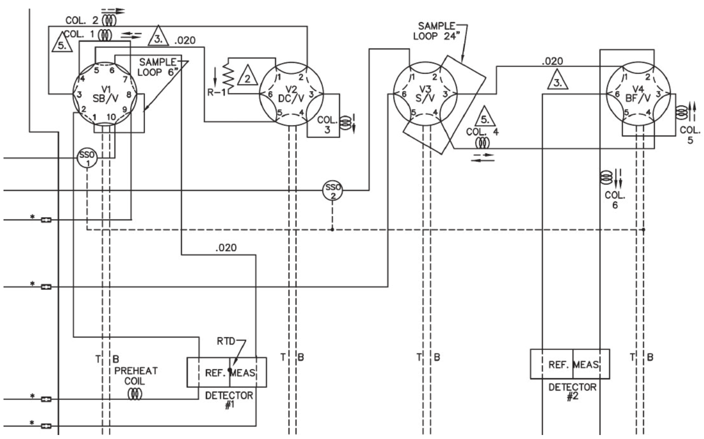
Analysis of Pipeline-Quality Gas Using a Rosemount™ 700XA Gas Chromatograph C9 Application (Five-Minute Analysis)

Emerson's Rosemount on-line chromatographs provide custody-transfer measurement of energy content in natural gas. To determine the heating value component of natural gas, first we must determine component concentrations. In a standard C6+ application, the analysis is performed using three valves and one Thermal Conductivity Detector (TCD) in a single oven (four-minute analysis time). To perform the C9+ application analysis, four valves and two TCDs are used in a single oven (five-minute analysis time). The results from both detectors are combined in post-analysis calculations and reported together.

Figure 1 - Flow Configuration for Measurement of C1–C9, N_2 and CO_2



Industry Background

Deregulation of the natural gas industry, coupled with high demand, has caused the composition of natural gas to be less consistent in recent years. Pipelines can now carry gas from a variety of sources, as market forces dictate. Furthermore, the increased demand of natural gas, mostly attributed to increased electricity requirements and air-pollution standards, has expanded the number of gas fields and producers.

Much of the new gas comes from Canada and the Northwestern US. This gas is quite rich with higher concentrations of relatively heavier hydrocarbons. Additionally, during periods when natural gas prices rise (such as winter periods), the gas may not be processed — leaving the heavier hydrocarbon gases (butane, propane, ethane — that would have normally been removed and sold) in the pipeline. Using a C9+ extended analysis gas chromatograph at these rich-gas custody transfer points enables a more accurate measurement than a standard C6+ analysis. Rather than assuming fixed percentages of the C6+ peak (as the C6+ application does per per Gas Processors Association (GPA) standards 2261), a C9+ analysis separates and measures the component hydrocarbon groups of C6, C7, C8, and C9+.

Analysis Method

This analysis is performed with two TCDs and five column sets. The first TCD measures nitrogen, carbone dioxide, and methane through normal pentane. The second TCD separates and measures heavier hydrocarbon component groups of C6 to C9+. Both measurements are made simultaneously in under five minutes.

Since there are many different components for each carbon number, some of the components within a given carbon number are completely separated from each other, and some are partially separated. Their collective peak areas are all calcuated and summed in what is called forced integration. This is a forced on and off time for all peaks to be integrated. The sum of all peak areas is then reported as the total peak area for that particular carbon number. The response factor is then used for further calculations to determine mole percentage.

Hydrocarbon Dew Point

Hydrocarbon dew point (HCDP) is the temperature, at a defined pressure, at which hydrocarbon liquids begin to form. Hydrocarbon liquids in the gas stream can cause hydrate formation, increase compression costs, cause issues with pressure regulator freezing, and lead to lead to equipment damage such as gas turbines.

The Hydrocarbon dew point changes with pressure and the presence of hydrocarbon liquid in a gas stream can indicate a two-phase flow, resulting in significant measurement errors. The 700XA C9+ can calculate HCDP at four different pressures and the cricondentherm, the highest HCDP at any pressure. The pressures can be fixed, or may be sourced from the modbus link or an analog input to enable the live calculation of HCDP at pipeline pressure. Calculation of the HCDP at the flowing pressure and comparing it to the flowing temperature can provide an alert if there is two-phase flow, providing an early warning that the flowing stream is approaching two-phase to enable mitigation efforts before it results in flow measurement errors.

Table 1 - Standard Measurement Ranges

Component		Range
C9+	Nonanes and heavier	(0–0.5 %)(*)
C8+	Octanes	(0–0.5 %)(*)
C7+	Heptanes	(0–0.1 %)(*)
C6+	Hexanes and heavier	(0–0.1 %)(*)
C3	Propane	(0–10 %)(*)
IC_4	Isobutane	(0–5 %)(*)
IC_5	Isopentane	(0–1 %)(*)
NC_5	Normal Pentane	(0–1 %)(*)
N_2	Nitrogen	(0–20 %)
C1	Methane	(65–100 %)
CO_2	Carbon Dioxide	(0–20 %)
C2	Ethane	(0–20 %)

(*) Heavier concentrations can be measured but may require a heated sampling system to prevent drop-out.

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