Hydrogen Sulfide Measurement in Refinery Fuel Gas Using a TCD-Based Gas Chromatograph

As part of the Clean Air Act Amendments (CAAA) passed by the U.S. congress in the early 1990s, a mandate for the measurement of hydrogen sulfide (H_2S) in refinery fuel gas went into effect. Since then, refineries have relied on gas analyzers to detect and determine the concentration of H_2S in fuel gas streams.

H_2S in refinery fuel gas

Refinery fuel gas is a collection of light gases generated in a number of processing units in the refinery. The light gases are first collected and processed in a gas processing unit to recover any heavier components of value that may be present and to remove most of the sulfur compounds such as H_2S. The remaining light gases are then used as fuel for process heaters and boilers.

Table 1 shows a typical composition of the refinery fuel gas. The actual chemical composition can vary dramatically due to several processing units that contribute light gases into the fuel gas. Due to this fluctuation, it is common for refineries to put online analyzers on the fuel gas process to track the changes in heat/BTU value for improved heater and boiler control.

Per the CAAA, the measurement of H_2S value in a refinery fuel gas is mandated whenever the fuel gas is used as a fuel for boilers and process heaters. However, many H_2S analyzers are maintenance-intensive. For instance, lead acetate tape analyzers rely on mechanical systems and sensors with short lifespans, adding a great deal of maintenance and operating costs. They also require special disposal procedures for the spent lead tape.

Figure 1 - Typical Chromatogram Showing H_2S PPM Level Measurement by a Rosemount TCD-Based Gas Chromatograph

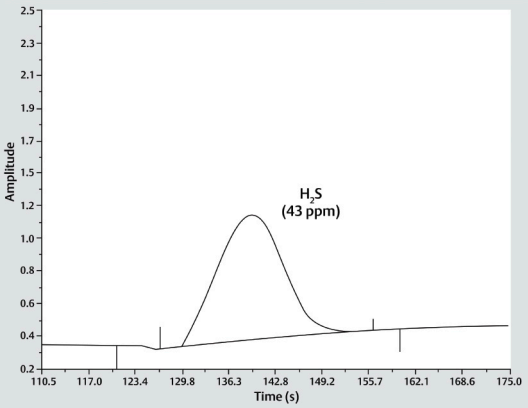

Table 1 - Typical Composition of Refinery Fuel Gas

	Typical Concentration
Hydrogen (H_2)	25%
Oxygen (O_2)	2%
Nitrogen (N_2)	5%
Carbon Dioxide (CO_2)	1%
Methane (C_1)	35%
Ethane (C_2)	15%
Ethylene (C_2=)	5%
Propane (C_3)	5%
Propylene (C_3=)	2%
C_4's	2%
C_5's	2%
C_6^+	1%
H_2S	150 ppm
BTU	900 BTU

H_2S detection

Emerson's Rosemount Gas Chromatograph is an ideal solution to H_2S measurement because it employs a simple, yet rugged thermal conductivity detector (TCD) capable of measurements in the low parts per million range. TCDs operate on the principal that all compounds have unique thermal conductivity properties. By comparing the thermal conductivity of the component to be measured against the properties of a reference gas (usually the chromatograph carrier gas), very precise measurements can be made. The Rosemount TCD can measure compounds such as H_2S down to 3 ppm detection levels – perfect for H_2S in fuel gas applications where the typical measurement range is 0 – 300 ppm. In addition, the very linear response of the Rosemount TCD makes it the best suited detector for such a wide range of H_2S measurement. For applications requiring sub-ppm H_2S measurement, Rosemount micro Flame Photometeric Detectors (µFPD) can be used to measure down to ppb levels with reliable accuracy and repeatability.

Rosemount Gas Chromatographs can also perform the daily high and low validation checks that are mandated by regulations. The process for validation gases can be automated and the software can check for alarm conditions and automatically log the data.

Using a TCD-based gas chromatograph is a practical and cost-effective measurement solution for plant operators because it enables other fuel gas measurements such as BTU content analysis without purchasing a second analyzer. Many refineries prefer to keep the fuel gas above a certain BTU level, so knowing the BTU content of the fuel gas optimizes the amount of pipeline quality natural gas needed to maintain the BTU/heating value above that minimum requirement. Using a gas chromatograph to perform both hydrogen sulfide and fuel gas energy content measurement simplifies the scope of analyzers and reduces the overall cost and footprint.

In addition to their versatile analytical capability, Rosemount Gas Chromatographs are field-mountable, transmitter-style analyzers that offer the lowest cost of ownership in the industry because they make process measurements at or near the sample point, greatly reducing the overall lifetime cost of the measurement. Expenses such as shelters, air conditioning, heating, and long/heated sample lines can be minimized or completely eliminated in most applications.

A powerful software package provides automated processing and ensures operators, maintenance personnel, and management have access to actionable process insights and performance diagnostics of Rosemount Gas Chromatographs. Secure, remote connectivity simplifies audit checks and reduces the need to attend remote locations.

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