Application Data Sheet
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Application Data

Measuring Hydrogen Sulfide In Refinery Fuel Gas with a Simple TCD-Based Gas Chromatograph

As part of the Clean Air Act Amendments (CAAA) passed by the U.S. congress in the early 1990s, the measurement of hydrogen sulfide (H_2S) in refinery fuel gas became mandated for most U.S. refineries. Since then, a number of sites are switching to on-line gas chromatographs using a simple and rugged thermal conductivity detector for the measurement.

H_2S IN REFINERY FUEL GAS APPLICATION

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 valuable heavier components that may be present as well as removing 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 was common for refineries to put on-line analyzers on the fuel gas process to track the changes in BTU value for improved heater and boiler control.

With the CAAA, the measurement of the H_2S value in the refinery fuel gas was mandated whenever the fuel gas was used as a fuel for boilers and process heaters. Since nearly every refinery used the fuel gas as a source of "free" fuel, measurement of H_2S in refinery fuel gas became a requirement nearly every refinery was faced with making.

Over the years, many refineries are finding that their choice of analyzer involved high levels of maintenance. Lead acetate analyzers were maintenance-intensive due to their very mechanical design. Lead acetate analyzers also required special disposal procedures for the spent lead tape. Refineries using on-line gas chromatographs with flame photometric detectors (FPD) were also seeing high levels of maintenance required to keep the FPDs flame lit and operating properly.

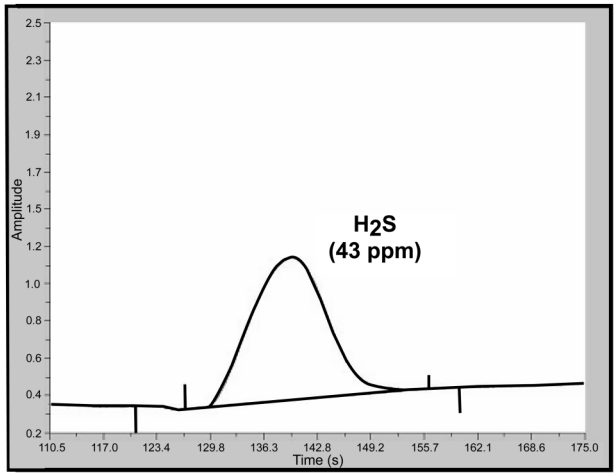

Figure 1 – Typical Chromatogram Of PPM Level H_2S Using A Thermal Conductivity Detector On The Rosemount Analytical Gas Chromatograph

EMERSON'S ROSEMOUNT ANALYTICAL GAS CHROMATOGRAPH SOLUTION

The on-line gas chromatograph from Emerson is a solid alternative for making the H_2S measurement. Rather than using a complicated, difficult-to-maintain FPD detector, the Rosemount Analytical gas chromatographs use a much simpler and rugged thermal conductivity detector (TCD) – even for measurements in the low parts-per-million range.

Thermal conductivity detectors work 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 Analytical TCD detector can measure compounds such as H_2S down to the 3 ppm detection levels – perfect for H_2S in fuel gas applications where the typical measuring range is 0-300 ppm.

The Rosemount Analytical gas chromatograph can also perform the daily high and low validation checks that are mandated by the regulations. Introduction of validation gases can be set up on an automated basis. The software of the analyzer can also automatically check the results for alarm conditions and log the data automatically.

Using a TCD enables other measurements to be made in the fuel gas such as the BTU content. Many refineries prefer to keep the fuel gas above a certain level so knowing the BTU content of the fuel gas optimizes the amount of pipeline quality natural gas this is needed to maintain the BTU above that minimum.

In addition to exceptional analytical capability, Rosemount Analytical gas chromatographs offer the lowest cost of ownership in the industry. Most process measurements can be made 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. Furthermore, Rosemount Analytical gas chromatographs are designed to operate unattended for long periods of time without adjustment. When adjustments are required, all components are easily accessible and can be performed in the field in minutes with standard tools.

	Typical Concentration	Measuring Range
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 %	
C4's	2 %	
C5's	2 %	
C6+	1 %	
H_2S	150 ppm	0 – 300 ppm
BTU	900 BTU	800 – 1200 BTU

Table 1 – Typical Composition Of Refinery Fuel Gas

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