Ammonia: fuel gas to reformer furnaces

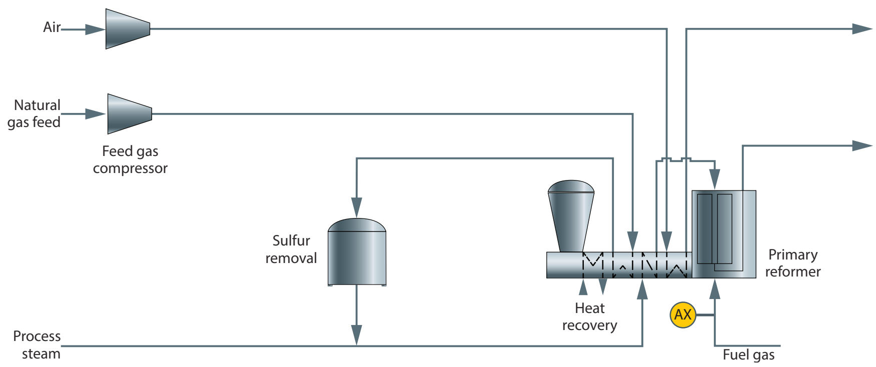

Figure 1: Typical fuel gas measurement point*

Benefits at a glance

- Unique spectroscopic capability to measure Btu in natural gas
- Pipe-centric sampling and measurement at the sample tap
- Sample can often be returned to process, avoiding disposal to flare header
- Complete fuel gas speciation
- No valves, columns, or carrier gas
- No routine calibration
- Fouling cannot damage the Rxn-30 optical probe and cleaning is easy
- No interference from moisture vapor

In petrochemical plants, fuel gas streams are typically made up of a blend of off-gases or waste gas streams which become the fuel for combustion systems like boilers and furnaces. In an ammonia plant, the off-gas or tailgas from pressure swing adsorption (PSA) units is typically redirected as fuel gas to the steam methane reformer (SMR). As this is a relatively low Btu value stream, the Btu content can be raised by blending it with the natural gas stream used as feed to the SMR. The analytical challenge is the ability to analyze a gas that may be quite variable in its stream composition.

Measurement of fuel gas composition and Btu

The Raman Rxn5 analyzer is a unique solution to the sampling and measurement of the fuel gas stream to the primary reformer furnace. A typical Raman spectrum and stream composition for a fuel gas stream is shown in Figure 2. Unique Raman peaks for a typical light natural gas stream (H_2, C_1-C_4) allow these components to be quantified for calculation of Btu. In addition, the ability of the Raman Rxn5 to simultaneously measure species not associated with Btu, such as N_2 and CO_2, contributes to the overall accuracy of the measurement. Speed of analysis may be important because of the dynamics of blending multiple off-gas streams to generate the fuel gas stream. The pipe-centric sampling interface eliminates lag time associated with sample transport, and update times can be as short as 60 seconds.

Reliability issues with traditional methods for fuel gas analysis

In general, fuel gas Btu is analyzed via speciation using process gas chromatography (GC) or mass spectrometry (MS). Alternatively, it is measured as a bulk physical property (e.g. Wobbe index analyzers correlate Btu with excess O_2 monitored during a combustion process internal to the analyzer). Both technologies require a low pressure sample and sample transportation if the analyzer cannot be located close to the sample tap point, which adds lag time, reducing the overall speed of analysis. In addition, while some bulk property analyzers provide fast analysis times, whenever there is a change in the Btu value, it is not possible to validate or troubleshoot the cause as no speciation of the components are available.

* See the general Ammonia: production analytics overview

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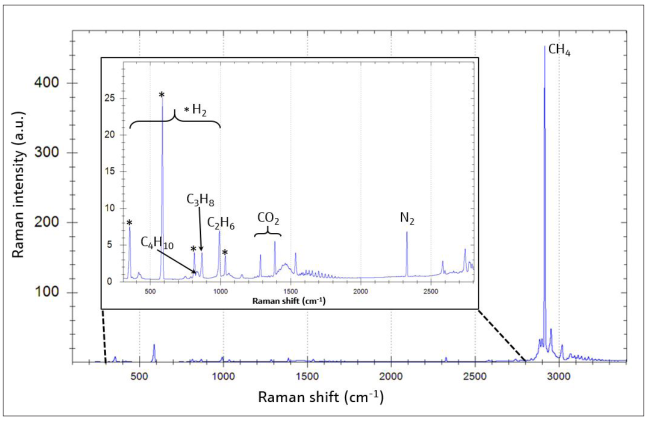

Figure 2: Raman spectrum of a typical fuel gas stream

Solution: Raman Rxn5 analyzer with the fuel gas to reformer furnaces method

In the case of relatively clean and dry streams like a natural gas feed, the Raman Rxn5 analyzer with an Rxn-30 probe allows for a wide range of sample pressure (70-800 psia typical) and sample temperature (-40 to 150 °C). The Rxn-30 probe can be easily integrated into sample conditioning systems to measure process streams at higher temperatures and pressures. The ability to measure at higher pressures often allows the sample to be returned to the process, eliminating waste and costly flaring. The use of fiber optic cables allows the probe to be placed at the sample tap location, eliminating the need for long heated sample transfer lines and sample lag time.

The Raman Rxn5 analyzer for fuel gas to reformer furnaces contains the following per measurement point:

- Dedicated laser module
- Rxn-30 fiber optic probe
- Industrial hybrid electro-optical cable (up to 150 m long, customized to your plant requirements)
- Combined pressure and temperature sensor with cable (up to 150 m long, customized to your plant requirements)
- Dedicated fuel gas to reformer furnaces method

Typical process conditions	P (barg)	T (°C)
At sample tap	5	40
At Rxn-30 probe	5	55

Typical stream composition

Component	Range (Mol%)	Normal (Mol%)	Precision (Mol%) k=2	Cal gas (Mol%)	Precision (Mol%) k=2
Methane	40-80	60	0.14	60	0.14
Ethane	5-20	9	0.04	9	0.04
Propane	0-10	4	0.03	4	0.03
Butane	0-10	3	0.05	3	0.05
Nitrogen	5-15	9	0.05	9	0.05
Carbon dioxide	0-10	5	0.04	5	0.04
Hydrogen	5-15	10	0.04	10	0.04

Table 1: Typical process conditions and stream composition

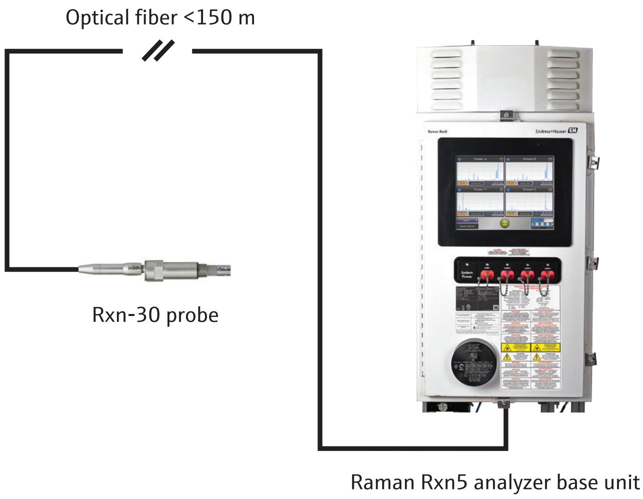

Figure 3: Recommended system configuration

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