Ammonia: methanator outlet – purified syngas

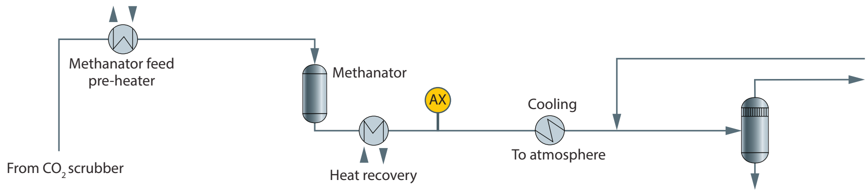

Figure 1: Typical methanator outlet measurement point*

Benefits at a glance

- Unique spectroscopic capability to measure all syngas components, including H_2 and N_2
- Pipe-centric sampling and measurement at the sample tap
- Sample can often be returned to the process - no sample flare
- Complete syngas speciation
- No valves, columns, or carrier gas
- No routine calibration
- No interference from moisture vapor in the raw syngas sample when the sample is kept above its dewpoint

The second stage of purifying the processed syngas after the CO_2 absorber unit is conversion of the residual CO_2 to CH_4 by hydrogenation in a methanator. See Figure 1 for a simplified process overview of the methanator hydrogenation process. CO_2 is a poison for the ammonia converter catalyst and any unconverted CO_2 can only be present at low ppmv levels. Note also that the CH_4 impurity is carried over to the NH_3 reactor where it is concentrated in the synthesis loop, which requires purging on a regular basis.

Measurement of purified syngas

The Raman Rxn5 analyzer is a unique integrated sampling and measurement solution for the methanator outlet stream. A typical Raman spectrum and stream composition for a methanator outlet stream is shown in Figure 2. Note the simplicity and complete speciation of individual spectral peaks in the spectrum. Any residual moisture still present in the stream after the methanator dryer is not visible in the frequency range of the spectrum. Hence, it cannot interfere with the analysis and a dry basis result is provided. No other spectroscopic technique is capable of measuring the H_2 and N_2 diatomics in this stream. In addition, the measurement is based on a normalized analysis, which makes it very robust against pressure and temperature changes as well as any slow fouling that may occur.

Reliability issues with traditional methods for purified syngas analysis

The methanator outlet stream is typically measured with process gas chromatography (GC) or mass spectrometry (MS). Both technologies require transporting the sample and doing sample conditioning at both the sample tap and at the sample conditioning panel close to the analyzer. Protecting the GC or MS analyzers from even small amounts of liquid carryover after the methanator dryer becomes the main sampling system challenge, as this event can damage columns in a GC or damage the ionization chamber in a MS. The Rxn-30 probe cannot be damaged by liquid carryover or fouling and cleaning is simple and straightforward.

* See the general Ammonia: production analytics overview

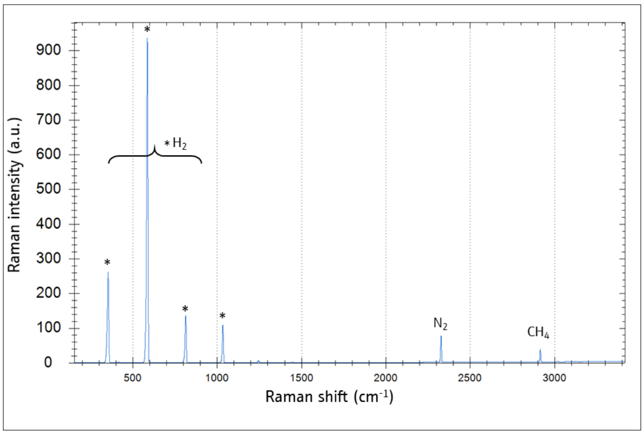

Figure 2: Raman spectrum of a typical purified syngas stream

Solution: Raman Rxn5 analyzer with the methanator outlet-purified syngas 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 at a lower pressure sampling point - flaring of the returned sample is avoided. Sampling lag time is essentially zero, as no sample transport is required, increasing the speed of analysis.

The Raman Rxn5 analyzer for the methanator outlet 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 methanator outlet method

Typical process conditions	P (barg)	T (°C)
At sample tap	29	330
At Rxn-30 probe	29	55

Typical stream composition

Component	Range (Mol%)	Normal (Mol%)	Precision (Mol%) k=2	Cal gas (Mol%)	Precision (Mol%) k=2
Hydrogen	55-95	73.7	0.04	74	0.03
Nitrogen	15-35	24.9	0.03	24	0.03
Methane	0-2	1.1	0.01	2	0.01
Argon	0-2	0.3	N/M	0	N/M

Table 1: Typical process conditions and stream composition

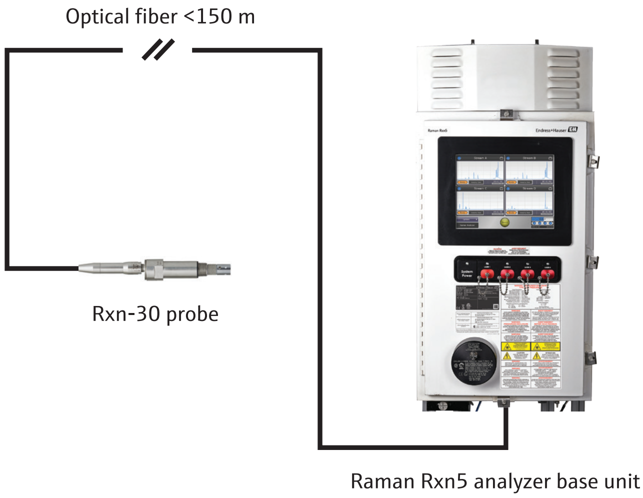

Figure 3: Recommended system configuration

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