Methanol: make-up syngas

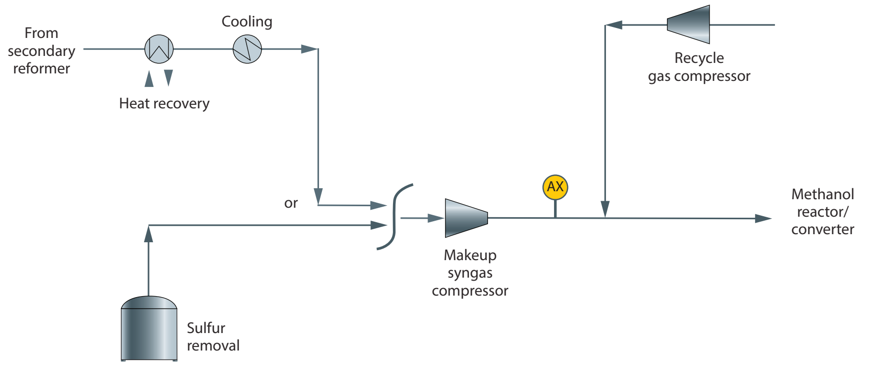

Figure 1: Typical make-up gas measurement point*

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 process, avoiding disposal to flare header
- Complete syngas speciation
- No valves, columns, or carrier gas
- No routine calibration
- No interference from moisture

In a modern methanol-producing plant, the syngas feed is usually generated via steam methane reforming (SMR) of natural gas, or via gasification of various feed stocks. The syngas from these sources is compressed prior to being combined with the recycle gas from the methanol reactor. The efficiency of methanol conversion can be optimized by measuring CO, CO_2, and H_2 in the syngas feed into the reactor. The M factor, or stoichiometric number, defined by the ratio $[H_2 - CO_2]/[CO + CO_2]$, is often used to optimize the efficiency of methanol conversion, with a desired value between 2.0 and 2.3. Measuring the composition of the feed gas streams in multiple locations allows blending to optimize this value. Measurement of the composition of the make-up gas is key to providing this level of control.

Measurement of make-up syngas

The Raman Rxn5 analyzer is a unique integrated sampling and measurement system for the syngas make-up stream. A typical Raman spectrum and stream composition for the make-up gas stream is shown in Figure 2. Note the simplicity and complete speciation of individual spectral peaks in the Raman spectrum. As the Raman Rxn5 is essentially transparent to moisture, any residual moisture leakage after the upstream driers does not interfere with the analysis as long as this residual moisture does not condense. Regardless of moisture content, the analysis results are provided on a dry basis. The Raman Rxn5 also uses 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 make-up syngas analysis

Make-up syngas is often analyzed using process gas chromatography (GC) or mass spectrometry (MS). Both technologies require transporting and conditioning the sample at both the sample tap and at the sample conditioning panel close to the analyzer. Due to low pressure, it typically is not possible to return the sample to process, so it must be sent to flare. Protecting the GC or MS analyzers from liquid carryover after the absorber dryer becomes the main sampling system challenge, as this event can damage columns in a GC or the ionization chamber in an MS. The Rxn-30 probe used by the Raman Rxn5 cannot be damaged by liquid carryover or fouling.

* See the general Methanol: production analytics overview

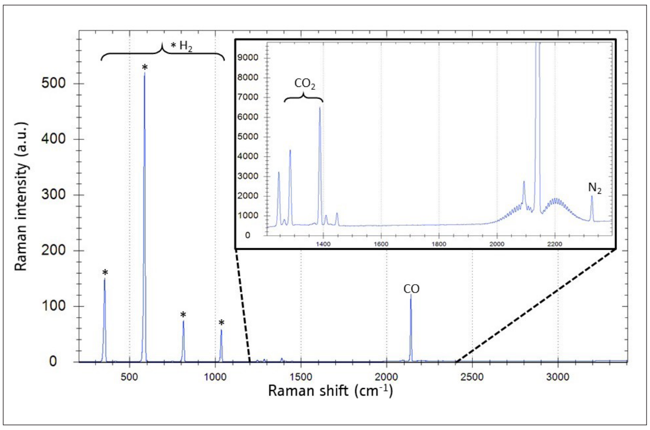

Figure 2. Raman spectrum of a typical make-up syngas stream

Solution: Raman Rxn5 analyzer with the make-up 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 make-up syngas 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 make-up syngas method

Typical process conditions	P (barg)	T (°C)
At sample tap	53	135
At Rxn-30 probe	53	53

Typical stream composition

Component	Range (Mol%)	Normal (Mol%)	Precision (Mol%) k=2	Cal gas (Mol%)	Precision (Mol%) k=2
Hydrogen	40-85	66.4	0.03	66	0.03
Nitrogen	0-2	0.6	0.01	1	0.01
Carbon monoxide	20-40	31	0.02	31	0.02
Carbon dioxide	0-2	2	0.01	2	0.01

Table 1: Typical process conditions and stream composition

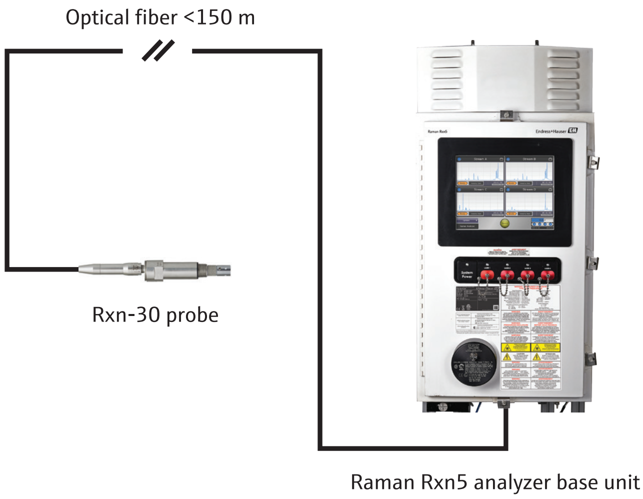

Figure 3: Recommended system configuration

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