Ammonia: low temperature shift converter outlet

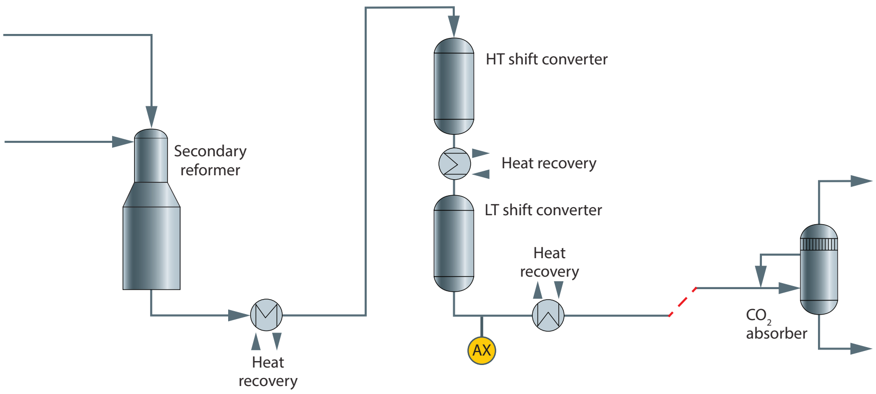

Figure 1: Shift converter process diagram sections*

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
- Complete syngas speciation
- No valves, columns, or carrier gas
- No routine calibration required
- No interference from moisture vapor in the raw syngas sample when the sample is kept above its dewpoint

The low temperature shift (LTS) converter is the second stage of the water shift conversion reactions to maximize the yield of H_2 by converting the remaining CO after the HTS into H_2 and CO_2. Steam injection flow is controlled by a feedback loop based on the measurement of the H_2 composition in the LTS effluent stream. The major analytical challenge for measuring this syngas type stream is the high temperature and steam saturated sample which traditionally have been a major problem in performing reliable sampling and analysis.

Measurement of LTS converter syngas

The Raman Rxn5 analyzer is a unique solution to sample and measure this particular process stream. A typical Raman spectrum for a LTS converter effluent stream is shown in Figure 2. Note the simplicity and complete speciation of individual spectral peaks in the spectrum. Any residual moisture present in the stream is not visible in the frequency range of the spectrum. Hence, it cannot interfere with the analysis and a dry basis result is provided. 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 LTS converter effluent analysis

The LTS converter outlet stream composition is typically measured with 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. In the case of the LTS converter outlet stream, the use of a dynamic reflux sampler (DRS) or alternative liquid removal system is mandatory. Protecting the GC or MS analyzers from liquid carryover becomes the main sampling system challenge as this event can damage the GC columns or MS ionization chamber. The Rxn-30 probe cannot be damaged by liquid carryover and cleaning is simple and straightforward.

* See the general Ammonia: production analytics overview

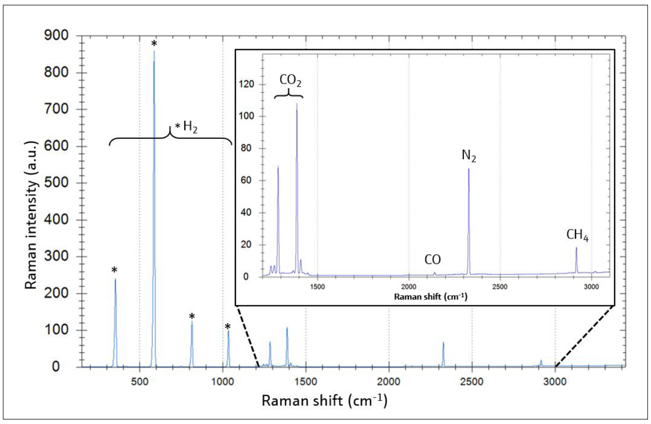

Figure 2: Typical syngas spectrum for the LTS converter effluent stream

Solution: Raman Rxn5 analyzer with the low temperature shift converter outlet method

The use of a liquid removal system is mandatory for the LTS converter outlet stream, which is saturated with steam at high temperature (typically 200-350 °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 for the low temperature shift converter 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 low temperature shift converter outlet method

Typical process conditions	P (barg)	T (°C)
At sample tap	31	220
At Rxn-30 probe	31	55

Typical stream composition

Component	Range (Mol%)	Normal (Mol%)	Precision (Mol%) k=2	Cal gas (Mol%)	Precision (Mol%) k=2
Hydrogen	40-95	61.17	0.03	64	0.03
Nitrogen	0-35	19.6	0.03	16	0.03
Carbon monoxide	0-35	0.2	0.01	7	0.02
Carbon dioxide	0-30	18.3	0.03	10	0.02
Methane	0-35	0.43	0.01	3	0.01
Argon	0-2	0.3	N/M	0	N/M

Table 1: Typical process conditions and stream composition

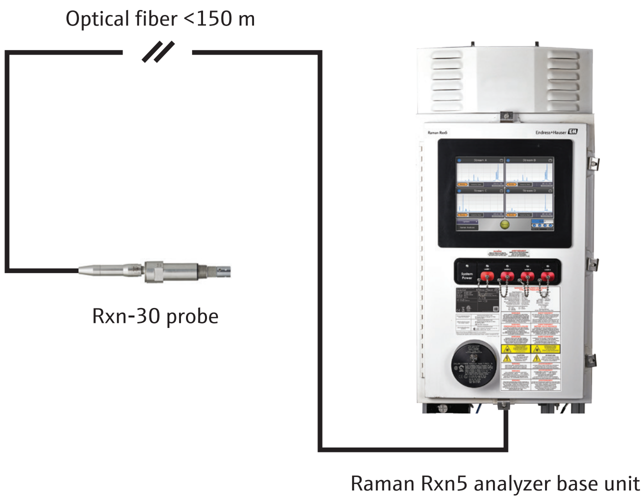

Figure 3: Recommended system configuration