SNG: shift converter outlet

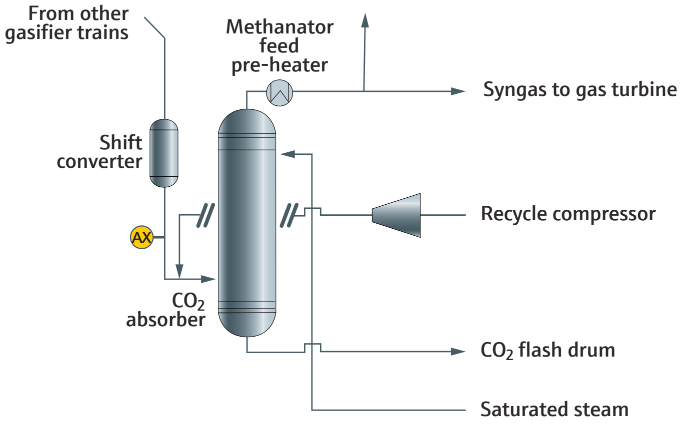

Figure 1: Shift converter process diagram sections of IGCC plant SNG process units*

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 interference from moisture vapor in the raw syngas sample when the sample is kept above its dewpoint

The H_2/CO ratio in synthesis gas produced by gasification systems varies with both feed type and gasifier design. When the goal of gasification is to produce methane rich SNG, some of the raw syngas is routed to a shift converter, which converts CO and steam to CO_2 and additional H_2. The output stream of the shift converter is mixed with the unshifted syngas in order to increase the H_2/CO ratio to at least 3, which is required for efficient methanation to produce high quality natural gas. The excess CO_2 can be captured pre-combustion (CCS) to reduce greenhouse gas emissions. The resulting syngas can either be routed to a methanator, and subsequently purified to produce pipeline ready SNG and pure hydrogen as a secondary product, or it can be become the fuel gas stream for a gas turbine for combined-cycle power generation.

Measurement of shift-converted syngas

The Raman Rxn5 analyzer is a unique solution to the sampling and measurement challenges for analyzing the output of a shift converter. A typical Raman spectrum for a syngas stream after the water shift reaction is shown in Figure 2. Note the simplicity and complete speciation of H_2, CO, CO_2 and CH_4 as individual peaks in the Raman spectrum. In addition, as the Raman Rxn5 is essentially transparent to moisture, the analysis represents a dry basis result. The Raman Rxn5 uses a normalized analysis which makes it very robust to changes in process pressure, temperature, and flow, as well as to any slow fouling that may occur.

Reliability issues with traditional methods for shift converter effluent analysis

In general, syngas is measured with process gas chromatography (GC) or mass spectrometry (MS). Both technologies require a low pressure sample and sample transportation if the analyzer cannot be located close to the sample tap point, adding lag time to the speed of analysis. In the case of the syngas stream shift converter, the use of a dynamic reflux sampler (DRS) or alternative liquid and particulate removal system is mandatory. Protecting the analyzer from liquid carryover is the main challenge as this event can damage columns in a GC or damage the ionization chamber in an MS. The Rxn-30 probe used by the Raman Rxn5 analyzer cannot be damaged by liquid carryover or fouling, and it can be easily cleaned.

* See the general IGCC plant SNG: production analytics overview

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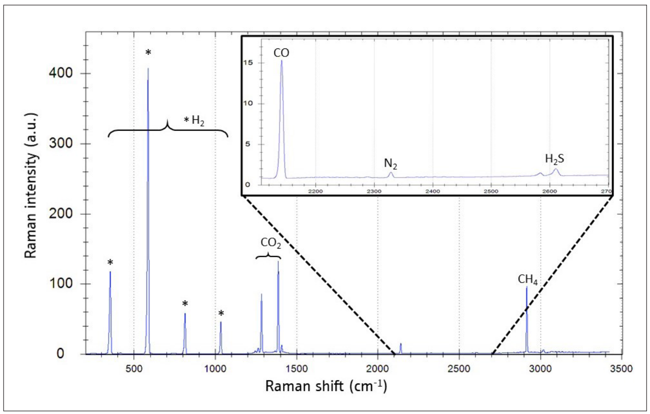

Figure 2: Typical Raman spectrum for shift converter outlet

Solution: Raman Rxn5 analyzer with the shift converter outlet method

The use of a liquid removal system is mandatory for a shift 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 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 shift converter outlet method

Typical process conditions	P (barg)	T (°C)
At sample tap	39	250
At Rxn-30 probe	39	45

Typical stream composition

Component	Range (Mol%)	Normal (Mol%)	Precision (Mol%) k=2	Cal gas (Mol%)	Precision (Mol%) k=2
Hydrogen	35-65	49.9	0.03	49	0.03
Nitrogen	0-2	0.3	0.01	1	0.01
Carbon monoxide	0-10	3.6	0.01	3.5	0.01
Carbon dioxide	35-55	43	0.04	42	0.04
Methane	0-10	3.9	0.01	4	0.01
Hydrogen sulfide	0-1	0.1	0.01	0.5	0.01

Table 1: Typical process conditions and stream composition

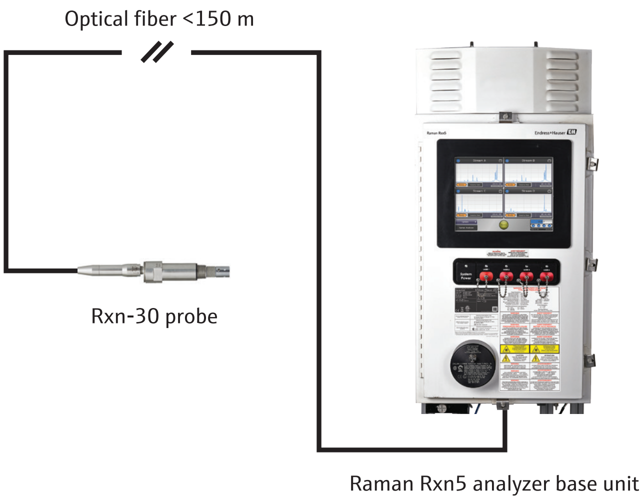

Figure 3: Recommended system configuration

AI01338C/66/EN/01.21