Captive hydrogen: CO_2 absorber outlet - feed to PSA

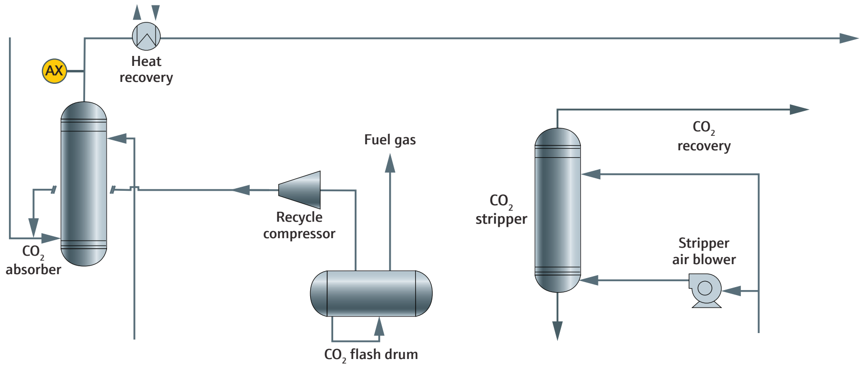

Figure 1: Typical CO_2 absorber outlet measurement point*

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

Introduction

The first stage of upgrading the syngas effluent from the shift converters is the removal of CO_2 that was produced during the reforming stage and subsequently by the water-shift reaction in the HTS and LTS converters. CO_2 (and H_2S) removal, generally known as acid gas removal (AGR), is typically done by solvent based amine treatment absorbers and regenerators or strippers. Figure 1 shows a simplified process overview of the CO_2 absorber/stripper units and measurement point. Other types of purification processes are also used, such as pressure swing adsorption (PSA).

Measurement of residual CO_2 in absorber outlet

The Raman Rxn5 analyzer is a unique integrated sampling and measurement solution for the CO_2 absorber outlet stream. A typical Raman spectrum and stream composition for this stream is shown in Figure 2. Note the simplicity and complete speciation of individual spectral peaks in the Raman spectrum. Any residual moisture present in the stream after the absorber 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 CO_2 absorber outlet analysis

In general, the CO_2 absorber outlet stream composition is 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. Protecting the GC or MS analyzers from even small amounts of liquid carryover after the absorber 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 Captive hydrogen: production analytics overview

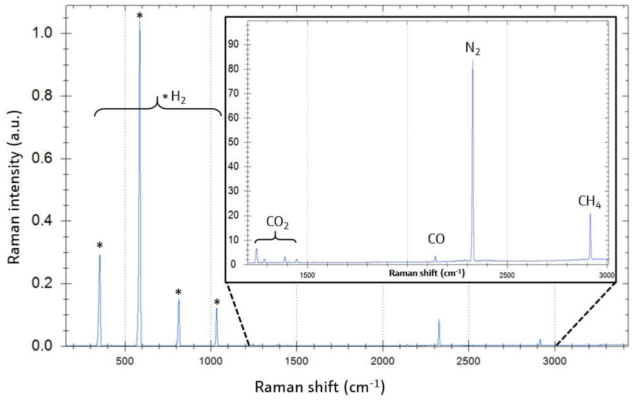

Figure 2: Raman spectrum of a typical CO_2 absorber outlet stream

Solution: Raman Rxn5 analyzer with the CO_2 absorber outlet - feed to PSA method

In the case of relatively clean and dry streams like the CO_2 absorber outlet stream, the Raman Rxn5 analyzer with Rxn-30 probe allows for a wide range of sample pressure (70 to 800 psia) and a 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 CO_2 absorber outlet-feed to PSA 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 CO_2 absorber outlet-feed to PSA method

Typical process conditions	P (barg)	T (°C)
At sample tap	31	25
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	74.1	0.04	64	0.03
Nitrogen	0-35	24.4	0.03	16	0.03
Carbon monoxide	0-35	0.3	0.01	7	0.02
Carbon dioxide	0-30	0.4	0.01	10	0.02
Methane	0-35	0.5	0.01	3	0.01
Argon	0-2	0.3	N/M	0	N/M

Table 1: Typical process conditions and stream composition

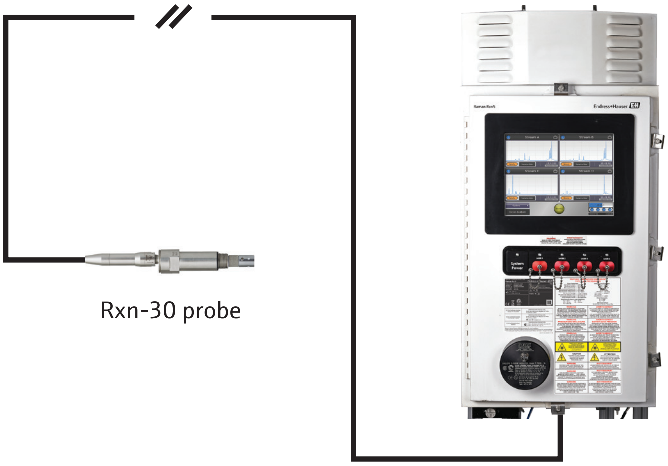

Figure 3: Recommended system configuration