Application Note

AM7: CO_2 absorber outlet – methanator inlet

Industry: Ammonia
Application Note AM7

Key Points

- Unique spectroscopic capability to measure all syngas components, including H_2 and N_2
- Pipe-centric sampling and measurement at the sample tap
- The OptoAST Sampling System is a unique front end to allow measurement at process P and T
- 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

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 solvent based CO_2 absorbers such as Selexol™ Solvent and Rectisol™ and Benfield™ processes are also in common use, whereas membrane separations are relatively new to AGR processes.*

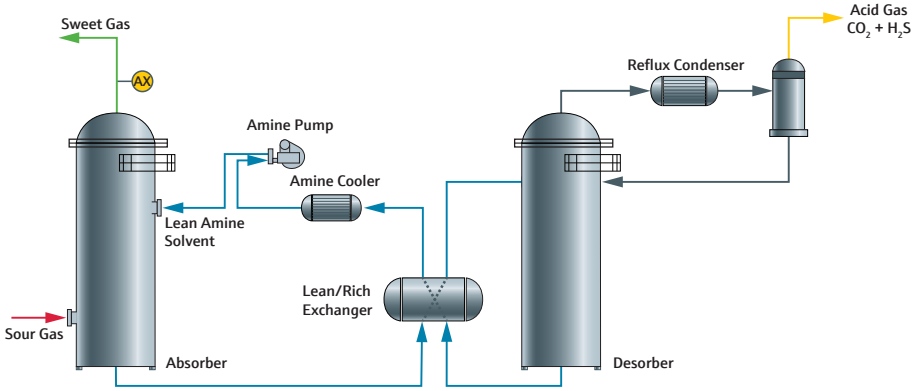

Figure 1: Typical CO_2 Absorber Outlet Measurement Point**

Measurement of residual CO_2 in absorber outlet The Optograf™ Analyzer combined with an OptoAST™ system is a unique integrated sampling and measurement solution for the CO_2 absorber outlet stream. A typical Optogram and stream composition for this stream is shown in Figure 2. Note the simplicity and complete speciation of individual spectral peaks in the Optogram. Any residual moisture still 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 carry-over 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 AirHead™ probe cannot be damaged by liquid carry-over or fouling and cleaning is simple and straightforward.

* Trademarks of Dow, Lurgi, and Honeywell respectively.

**See the general Ammonia Production Overview Application Note (AM0).

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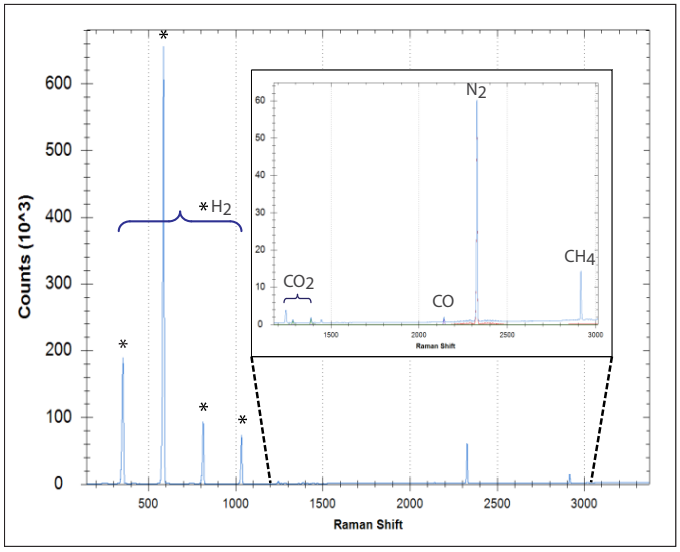

Figure 2. Optogram of a Typical Absorber Outlet Stream

Typical Process Conditions	P (barg)	T (°C)
At Sample Tap	31	25
At AirHead™ 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

The solution: Optograf™ Analyzer CO_2 absorber outlet – methanator inlet application kit. In the case of relatively clean and dry streams like the CO_2 absorber outlet stream, the recommended pipe-centric sampling interface and system configuration for the Optograf Analyzer is the OptoAST module (see Figure 3). The OptoAST Sampling module and integrated AirHead™ optical probe are designed for operating at line pressure and temperature, allowing the sample to be returned to the process at a lower pressure sampling point – flaring of the returned sample is avoided. Finally, sampling lag time is essentially zero, as no sample transport is required, resulting increased speed of analysis.

The Optograf Raw Syngas – primary reformer outlet application kit consists of the following:

- Laser Module with installation kit
- AirHead™ Fiber Optic Probe
- Fiber Optic Cable (length from 15 to 150 meters, customized to your plant requirements)
- Dedicated syngas primary reformer outlet Method

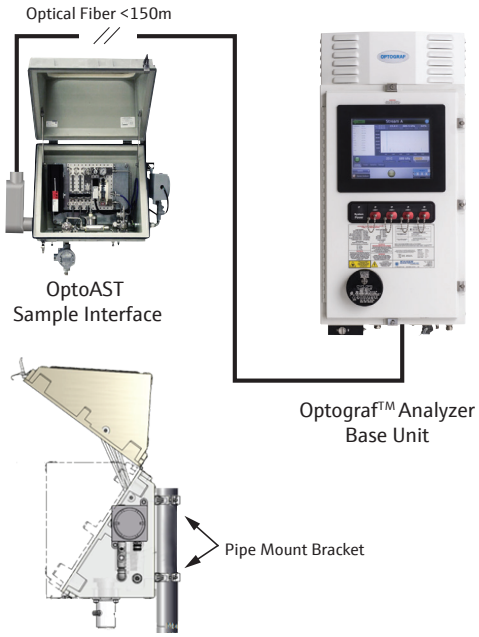

Figure 3: Recommended System Configuration