Application Note

AM9: Ammonia converter feed stream

Industry: Ammonia Application Note AM9

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 requires no sample transport to the analyzer
- The OptoAST Sampling System is a unique front end to allow measurement at process P and T
- Sample can often be returned to the process - no sample flare
- Complete syngas speciation
- No valves, columns, or carrier gas
- No routine calibration
- No interference from moisture

The feed to the ammonia converter is primarily a binary mixture of H_2 and N_2 with small amounts of NH_3 (residual NH_3 vapor after the liquefaction stage) and CH_4 as an impurity, which is slowly concentrated in the synthesis loop. It is critical that the ratio of H_2 to N_2 in the feed be kept at 3:1. Therefore, the accurate measurement of this ratio is the main challenge for the analytical measurement.

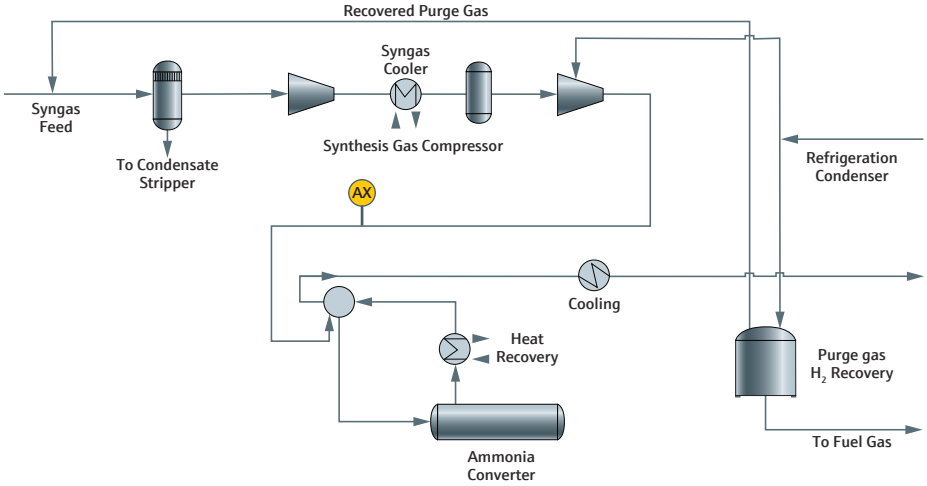

Figure 1: Typical Ammonia Converter Feed Measurement Point*

Measurement of the feed gas to the ammonia converter The Optograf™ Analyzer combined with an OptoAST™ system is a unique integrated sampling and measurement system for the NH_3 synthesis loop feed gas. A typical Optogram and stream composition for the ammonia converter feed are shown in Figure 2 and Table 1. Note the simplicity, baseline separation and complete speciation of the H_2, N_2, NH_3, and CH_4 spectral peaks in the Optogram, which allows for a very accurate measurement of the H_2:N_2 ratio. 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 improves the accuracy of the H_2:N_2 ratio, improves robustness against pressure and temperature changes, and significantly reduces the impact of any slow fouling that may occur.

Reliability issues with traditional methods for NH_3 feed gas analysis Typically, the NH_3 feed gas is analyzed via process Gas Chromatography (GC) or Mass Spectrometry (MS). Both GC and MS technologies require substantial pressure reductions and very fast loop flows to try and minimize sample transport lag times. The complexity of the multi-stream configurations for both GC and MS installations significantly increases maintenance support requirements and cost. In the case of GCs, analysis update times suffer because of sequential stream switching on top of long analysis times for any given stream.

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

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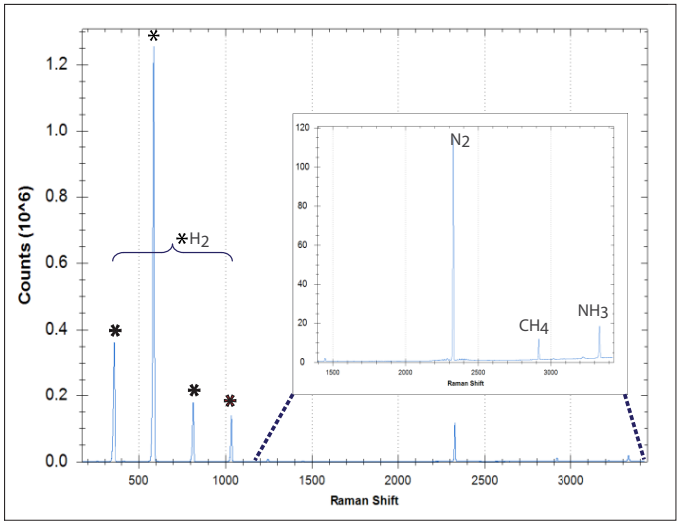

Figure 2: Optogram of a Typical Purified Syngas Stream

Typical Process Conditions	P (barg)	T (°C)
At Sample Tap	57	400
At AirHead™ Probe	57	55

Typical Stream Composition

Component	Range (Mol%)	Normal (Mol%)	Precision (Mol%) k=2	Cal Gas (Mol%)	Precision (Mol%) k=2
Hydrogen	35-90	71	0.03	65	0.03
Nitrogen	5-35	23.6	0.02	20	0.02
Methane	0-20	0.2	0.01	9	0.01
Ammonia	0-25	1.8	0.01	6	0.01
Argon	0-12	3.4	N/M	0	N/M

Table 1: Typical Process Conditions and Stream Composition

The solution: Optograf™ Analyzer ammonia converter feed stream application kit. In the case of a clean and dry stream like the ammonia converter feed stream, the recommended pipe-centric process and sampling interface and system configuration for the Optograf Analyzer is the OptoAST module (see Figure 3). The ammonia converter operates at high pressure and, in this case, some pressure reduction from typically 2200 psig to about 500 psig is required. This is still adequate pressure to allow the analyzer sample to be returned to a lower pressure process point, which avoids flaring the sample. This integrated solution provides an increase in analysis speed, since the sampling and measurement are done at the sample tap point and no sample transport is required.

The Optograf Natural Gas Feed to primary reformer 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

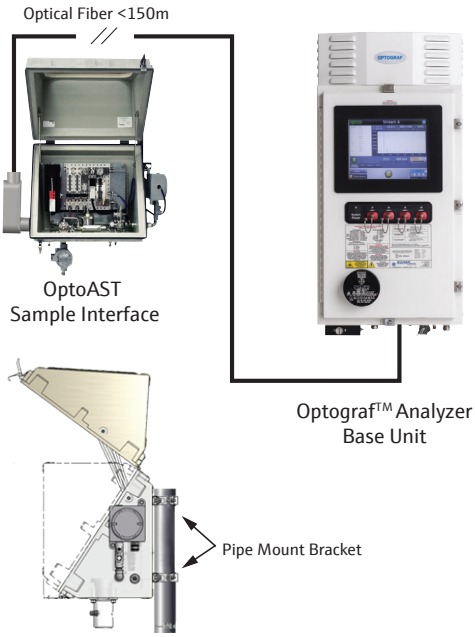

Figure 3: Recommended System Configuration

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