CASE STUDY • CHEMICAL

ETHYLENE PRODUCER ENSURES HIGH QUALITY OF PRODUCT USING MEASUREMENTS FROM A QUANTUM CASCADE LASER GAS ANALYZER

Customer

BASF (Badische Anilin- und Sodafabrik), a European multinational company and the largest chemical producer in the world.

Application

Ethylene product purity verification prior to injection of ethylene into a transmission pipeline system spanning Germany, Belgium, and the Netherlands.

Challenge

Ethylene purity must be certified by measuring certain key contaminants once the product leaves the fractionator and before its distribution via the ARG mbH & Co. KG (ARG) pipeline that spans 495 km across Germany, Belgium, and the Netherlands. This facility is the backbone of Central European ethylene production, with a pipeline network linking Antwerp to Cologne and the Ruhr industrial area. Before shipment, ethylene must be analyzed to ensure that it meets product specifications. This step is critical to the end users, and thus the profitability of ethylene producers.

BASF has previously used gas chromatograph (GC) technology, but it was looking to implement advanced gas sensing and analysis technology as part of an upgrade to their ethylene purity monitoring systems. Response time is critical during the delivery process of the final product. GCs are accurate but deliver data in minutes, which is not sufficient for real-time process control, where measurement data must be available continuously, with updates every few seconds.

A solution was needed to deliver measurement of various gas analytes without the deployment of multiple analyzers. Using just one analyzer would save space and reduce capital cost, while minimizing required maintenance.

Results

- Optimized product purity certification process with faster and highly reliable measurement analysis of trace impurities
- Ensured on-spec ethylene product with continuous, real-time monitoring of multiple contaminants
- Saved costs and reduced required footprint with high-sensitivity impurity analysis of multiple gas components using a single analyzer

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Solution

A quantum cascade laser-based continuous gas analyzer (Figure 1) was used to replace the GC because it provides both speed and precision of measurement, while detecting multiple components simultaneously. BASF utilized Emerson's Rosemount CT5800 Continuous Gas Analyzer to verify ethylene product quality through real-time impurity monitoring of key analytes—including CH_4, NH_3, C_2H_2, CO, CO_2, and C_2H_6—all with a single device.

The analyzer uses a zero-gap design (Figure 2) to eliminate the external light path, commonly used in traditional laser measurement, and to prevent the interference of atmospheric gases by close-coupling the lasers and detector to the measurement cell.

Implementing a zero-gap measurement methodology is possible when the external path spectral contribution is eliminated by reducing the laser beam's atmospheric exposure to near zero. This novel approach uses an innovative mechanical and optical design to prevent any contribution to the spectrum arising from a laser beam path external to the measurement cell. This design also enables detection of sub-ppmv levels of H_2O, CO_2 and other gases, without the requirement to purge the analyzer housing.

By using zero-gap and other technologies, the analyzer provides highly sensitive CO_2 measurement within a 0-5 ppm range, and a sub-ppm limit of detection of 0.05 ppm. This degree of measurement analysis performance is critical for continuous product purity certification prior to storage or transport.

Response time is also critical in product certification to perform closed-loop control of the ethylene production process. Based on measurements provided by the analyzer, the control system can automatically adjust process parameters to keep product within specified limits.

The Rosemount CT5800 Continuous Gas Analyzer continuously analyzes the gas with a measurement update rate of less than 1 second. The output is effectively continuous and in real time, and it is delivered to the control and monitoring system via Modbus over Ethernet TCP/IP or Analog 4-20 mA outputs.

This fast, online detection—coupled with a high degree of measurement accuracy—helps BASF meet its needs for product certification and delivery. The company was able to

Figure 1: BASF used Emerson's Rosemount™ CT5800 Continuous Gas Analyzer for real-time analysis of multiple gas components, ensuring ethylene product quality and eliminating the need to deploy multiple analyzers.

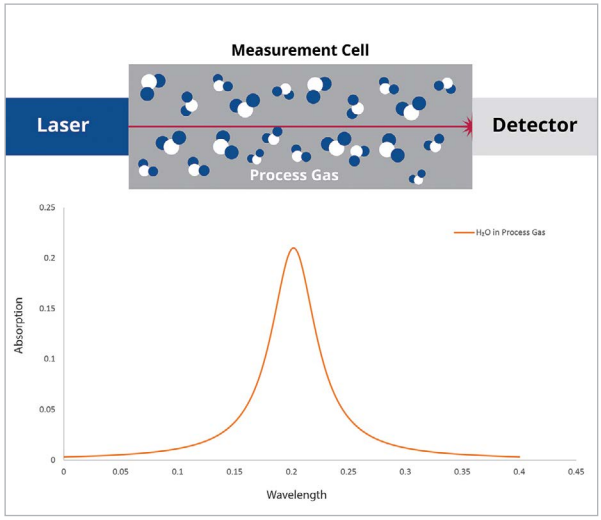

Figure 2: With zero-gap design, the laser beam does not travel through the atmosphere. With this configuration, the optical design removes the need for the laser to traverse an air gap before the measurement cell, removing any potential for interference and ensuring accurate process gas analytics.

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use one system to measure multiple gas components, eliminating the need for deploying multiple analyzers, while reducing maintenance costs and required footprint.

This single analyzer with five lasers is configured to measure multiple impurities as follows:

Gas	Range/ppmv	LOD/ppmv
CH_4	0-1000	10
NH_3	0-10	0.2
C_2H_2	0-20	0.2
CO_2	0-5	0.05
CO	0-5	0.05
C_2H_6	0-1000	10

> *Emerson's laser-based continuous gas analyzer provided speed, precision and reliability, ensuring on-spec ethylene product.*

Resources

Hydrocarbon Processing Magazine Articles:

- Optimizing Ethylene Production with Laser Technology
- Optimal Gas Analysis Decisions Improve Ethylene Plant Operation

Rosemount CT5800 Continuous Gas Analyzer:

- Emerson.com/RosemountCT5800

For more information, visit
Emerson.com/RosemountQCLAnalyzers

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