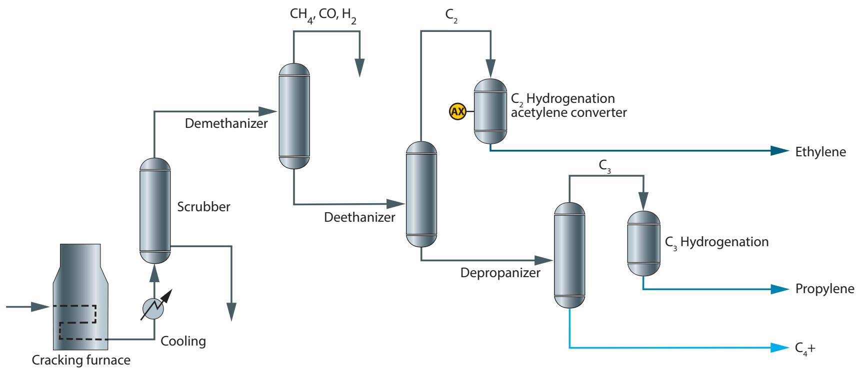
# Petrochem: $C_2H_2$ in mid-bed of back end acetylene converters




Back end acetylene converter

### Benefits at a glance

- Extremely fast response to $C_2H_2$ concentration changes critical for process control of hydrogenation reaction
- Laser-based measurement is highly selective and accurate for $C_2H_2$
- Non-contact laser measurement avoids fouling and corrosion for reliable long-term operation
- Low maintenance and OPEX costs – no cylinders of carrier gas or other consumables

## Controlling acetylene in olefin plants

Management of acetylene in ethylene directly affects the operational efficiency and profitability of olefin plants. Separating acetylene ($C_2H_2$) from ethylene ($C_2H_4$) is difficult due to the similar volatility of these gases. A catalytic hydrogenation reaction step is typically employed to convert acetylene into ethylene. An acetylene converter unit consists of a series of reactors or a single vessel with multiple catalyst beds. The concentration of $C_2H_2$ is reduced from thousands of ppmv at the inlet of an acetylene converter to hundreds of ppmv at the mid-bed down to low ppmv or ppbv levels at the outlet of the converter.

## Acetylene measurement

Controlling the acetylene to hydrogen ratio inside the converter is critical for optimization of ethylene production. On-line measurement of $C_2H_2$ facilitates control of the hydrogenation conditions. Gas chromatography (GC) has been the conventional technique for acetylene measurements. Analysis time using GC can extend to several minutes, during which time the operating conditions and $C_2H_2$ concentration inside the converter can change before chromatographic results are available. The time interval required to complete a chromatographic run may fail to detect an excursion. Early indication of a change in $C_2H_2$ concentration enables the operator to take actions to reestablish normal reaction conditions and avoid taking the process off line or routing the gas to flare.

## Endress+Hauser's solution

Tunable diode laser absorption spectroscopy (TDLAS) is a SpectraSensors technology that has proven highly effective for this critical process control measurement. TDLAS analyzers have an extremely fast response to changes in acetylene concentration (seconds versus minutes), an important performance characteristic for process control and optimization of hydrogenation conditions in acetylene converters. This real-time monitoring capability cannot be matched by a GC system. Laser and detector components are isolated and protected from process gas and contaminants avoiding fouling and corrosion and ensuring stable long-term operation.

Endress+Hauser
People for Process Automation

**Application data**

| | |
|---|---|
| Target component (Analyte) | $C_2H_2$ at mid-bed of back end acetylene converter |
| Typical measurement ranges | 0 - 3000 ppmv* |
| Typical repeatability | ±100 ppmv* |
| Measurement response time | 1 to ~60 seconds* |
| Principle of measurement | Non-differential tunable diode laser absorption spectroscopy (TDLAS) |
| Validation | Certified standard in a balance that matches the normal stream composition |

*Application specific; consult factory.

**Typical background stream composition**

| Component | Unit | Typical concentration | Min for application | Max for application |
|---|---|---|---|---|
| Hydrogen ($H_2$) | ppmv | 0 | 0 | 1000 |
| Carbon monoxide (CO) | ppmv | 0.5 | 0 | 1000 |
| Carbon dioxide ($CO_2$) | ppmv | <1.0 | 0 | 1000 |
| Methane ($CH_4$) | ppmv | 50-100 | 0 | 1000 |
| Ethane ($C_2H_6$) | mol% | 33 | 0 | 40 |
| Ethylene ($C_2H_4$) | mol% | 65 | 60 | 90 |
| Acetylene ($C_2H_2$) | ppmv | 750 - 1500 | 0 | 5000 |
| Propylene ($C_3H_6$) | ppmv | 3000 | 0 | 5000 |
| Total | mol% | 100 | | |

The background stream composition must be specified for proper calibration and measurement performance. Specify the normal composition, along with the minimum and maximum expected values for each component, especially acetylene, the measured component. Other stream compositions may be allowable with approval from Endress+Hauser.

www.addresses.endress.com

AI01285C/66/EN/01.21

Endress+Hauser
People for Process Automation