

## REFINERY SOLUTIONS

# Real-Time Measurement for Unparalleled Safety and Control

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Analyzer solutions to reduce process downtime, ensure safe operation, and optimize production efficiency in refinery operations.

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## AMETEK PROCESS INSTRUMENTS

Crude oil is processed into useful fuel such as gasoline, petroleum naphtha, diesel fuel, lubricants, asphalt base, heating oil, and kerosene at petroleum refineries all over the world. The conversion of crude oil into useful end products requires many processes, such as hydrocracking, hydrotreating, distillation, and sulfur recovery, just to name a few. Refinery operators need to ensure safe operation while maximizing process efficiency to optimize final product quantity and quality, while operating under increasing regulatory and environmental requirements. AMETEK Process Instruments supports refinery operators with these goals through our robust line of process analyzers.

### AMETEK, Inc.

AMETEK Process Instruments is a worldwide manufacturer of process analyzers and instrumentation. We focus our experience on designing new, innovative analyzers that help our customers achieve higher levels of productivity and quality. By seeking out ways to overcome the limitations of current methods of process monitoring, control, and quality assurance, we have created some of the most capable, unique technologies in the world.

A business unit of the Process and Analytical Instruments division of AMETEK, Inc., we are part of a global corporation with a growth plan founded on four key strategies: Operational Excellence, Strategic Acquisitions, Global & Market Expansion and New Products.

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## COMBUSTION CONTROL AND BOILER SAFETY

Process safety and optimized combustion control are essential for operating today's fired equipment through the measurements of excess oxygen (O<sub>2</sub>) and combustibles (CO+H<sub>2</sub>).

Reliable indication of low-combustion O<sub>2</sub> is critical to the effectiveness of the Burner Management System in a fired heater or boiler. Monitoring CO+H<sub>2</sub> enables operators to optimize air-fuel ratios at the burner and detect potential hazards of incomplete combustion, which pose an explosion hazard.

Key considerations:

- Optimize combustion efficiency and minimize emissions
- Minimize excess combustion air to reduce unneeded fuel consumption
- Detect the onset of incomplete combustion and operate within safe levels of combustibles

### AMETEK ADVANTAGE

- Real-time combustion control
- SIL-2 capable for O<sub>2</sub>
- Fully field serviceable
- Low cost of ownership
- Versatile mounting styles

## CONTINUOUS CATALYTIC REGENERATION

Continuous Catalytic Regeneration (CCR) is part of the catalytic reforming process in a refinery where hydrogen and naphtha feed are reacted to create desired end products. The catalyst used in the reaction is continuously flowing through the reactors and then regenerated. The efficiency of the regeneration process impacts the yield and quality of the end products.

Key considerations:

- Maximize catalyst life by carefully controlling O<sub>2</sub> levels to prevent thermal damage to catalyst
- Optimize operation of CCR for production and quality of final product

### AMETEK ADVANTAGE

- Real-time control to extend the life of the catalyst
- Easy to integrate into a process control loop
- Dual safety valves for servicing
- All-Hastelloy C sample stream available as an option

## PRODUCT SOLUTIONS

MEASURES: O<sub>2</sub>, Combustibles (CO+H<sub>2</sub>), CH<sub>4</sub>

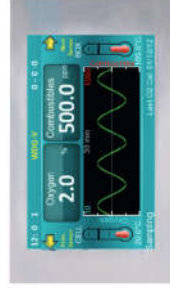
### WDG-V combustion analyzers

The Thermo WDG-V combustion analyzer has been designed to provide an additional layer of safety with the measurement of excess O<sub>2</sub>, combustibles, CO+H<sub>2</sub>, and methane (CH<sub>4</sub>) and by using these measurements to ensure the safe operation of the Burner Management System.



### AMEVision display unit for WDG-V

As the graphical user interface for the WDG-V, the AMEVision connects up to eight units, provides and communicates trend data, maintenance and troubleshooting information via Modbus or Ethernet LAN.



## PRODUCT SOLUTIONS

MEASURES: O<sub>2</sub>

### WDG-V UOP

The WDG-V UOP is specifically designed to monitor oxygen content in CCR processes with high reliability. It uses a nitrogen-operated aspirator to draw a sample of gas from the catalyst regenerator. A portion of this gas passes over the zirconia sensor. Because the aspirator gas contains no oxygen, the sample can simply be returned to the regenerator.

Dual isolation valves allow the sensor to be replaced without shutting down the CCR process, allowing very high availability to be maintained. In addition, the entire sample stream is heated above the sample dew point, so there is no risk of corrosion.



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## HYDROGEN RECYCLE/SEPARATION

Catalytic reforming is a chemical process used to convert petroleum refinery heavy naphthas, having relatively low octane value, into high-octane liquid products called reformates. The catalyst used in the reforming process can be inactivated by hydrogen sulfide (H<sub>2</sub>S), so it is important to measure H<sub>2</sub>S concentrations and reduce catalyst replacement expenses. Water (H<sub>2</sub>O) must also be measured, to reduce the formation of acids that can cause corrosion and damage to catalytic reformer units.

### Key considerations:

- Fast measurements of H<sub>2</sub>O and H<sub>2</sub>S, to minimize potential damage to equipment or catalyst
- Accurate measurement of the components of interest, that are typically present at ppm levels
- Maximum uptime of the measurement system
- Remote access to measurement system data and operational status

## AMETEK ADVANTAGE

- AMETEK 5100HD utilizes TDLAS that responds to concentration changes in seconds versus minutes
- Laser line lock verification system ensures the 5100HD is measuring the wavelengths of interest
- Uptime is maximized, as the sample being analyzed never contacts the laser source or measurement sensor

## PRODUCT SOLUTIONS

MEASURES: H<sub>2</sub>O, H<sub>2</sub>S

### 5100HD (single or dual laser)

For over a decade, and at installations around the globe, the AMETEK 5100HD TDLAS analyzer has provided continuous and accurate measurement of components of interest to refinery operation teams. Using sealed reference cells for continuous on-line analyzer verification, the 5100HD offers low maintenance, high specificity, sensitivity and fast-response speeds in many refinery applications.

The 5100HD may be configured to include multiple lasers and cells in an oven which can be run at temperatures up to 150°C (302°F), to simultaneously measure multiple components in one stream, or independently analyze one component in two different streams.



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## MOISTURE IN REFINERY APPLICATIONS

### APPLICATIONS

#### Catalytic reforming

Proper moisture balance in feedstocks and hydrogen recycle streams must be maintained to optimize product yield and catalyst life. Measurement reliability is greatly complicated by the presence of compressor oils and high boiling point hydrocarbons in the stream. The reformer process typically requires accurate and rapid results despite variations in moisture content from 10 to 25 parts per million (ppm).

### PRODUCT SOLUTIONS

MEASURES: H<sub>2</sub>O

#### 5000

The 5000's accuracy, reliability, and fast response are not affected by normal reformer contaminants such as compressor oils and high boiling point hydrocarbons. The on-board moisture generator verifies measurement accuracy for optimum product yield. Readings are absolute and provable, not just trends.



#### 3050-OLV

The 3050-OLV Moisture Analyzer combines quartz crystal accuracy with on-line verification in a cost-competitive package. It is a highly sensitive moisture analyzer, designed for catalytic reformer feed streams that require continuous and reliable measurement of parts per million by volume (ppmv).

The 3050-OLV has an online verification capability and a permeation tube that allows for verification and calibration of the analyzer. Delivering a fast response to changes in moisture levels, the 3050-OLV is ideal for catalytic reformer feed streams where accurate low ppm values are required.



#### 5100HD

Based on tunable diode laser absorption spectroscopy (TDLAS), the 5100HD TDLAS analyzer can continuously and accurately measure ppm moisture concentrations in catalytic reformer feed streams. TDLAS analyzer measurements are not impacted by contaminants like heavy hydrocarbons or oils, as the wavelength of interest is highly selective to water (H<sub>2</sub>O). If the dual laser option is selected, the 5100HD can also measure ppm levels of hydrogen sulfide (H<sub>2</sub>S) in the reformer feed gas.



#### Key considerations:

- Ability to quickly detect upsets at low moisture concentrations
- Capability to rapidly respond to dry down condition following a process correction
- Low maintenance and calibration costs
- Low lower detectable limit

### APPLICATIONS

#### Moisture in olefins

Ethylene (C<sub>2</sub>H<sub>4</sub>) polymerization catalysts are extremely sensitive to trace (H<sub>2</sub>O). H<sub>2</sub>O decreases catalyst activity and may turn the catalyst black, leading to discoloration of the virgin polymer. Accurate, reliable, and rapid sub-1 ppm moisture analysis is required.

### PRODUCT SOLUTIONS

#### 5000

The 5000's quartz-crystal sensor does not promote unsaturated hydrocarbon polymerization, a common problem with electrolytic moisture sensors. Exceptional response speed and precision in the sub-1 ppm moisture range ensures consistently high product quality. The on-board moisture generator verifies measurement accuracy.



#### 3050-DO

The 3050-DO is ideal for applications that require very low moisture content (0.02 to 100 ppm). Accurate sub-ppm level moisture detection can be achieved with rapid response time to changes in process conditions.

The online National Institute of Standards and Technology (NIST) traceable moisture generator provides verification capability and, if needed, calibration.



#### 5100HD

The 5100HD TDLAS analyzer can continuously and accurately measure ppm moisture concentrations in streams with high amounts of olefins, as the wavelength of interest is highly selective to H<sub>2</sub>O.

With an oven heater that can be run up to 150°C (302°F), most streams of interest will stay in the gas phase through the complete analysis.



### AMETEK ADVANTAGE

- Online verification of the analyzer eliminates downtime due to calibration
- Fast response to both wet-up and dry-down changes in the moisture content
- Excellent accuracy at low moisture concentrations

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## MOISTURE IN REFINERY APPLICATIONS

### APPLICATIONS

#### Moisture in natural gas

Natural gas is common feedstock for on-site production of hydrogen using steam methane (CH<sub>4</sub>) reformers and for production of ethylene. Natural gas is also a common fuel used for process heaters within various refinery process units. Fast responding, accurate moisture readings are required to ensure the quality of the natural gas meets the process specifications.

### PRODUCT SOLUTIONS

#### 3050-OLV

The 3050-OLV has online verification and a permeation tube that allows for verification and calibration of the analyzer. The 3050-OLV is desirable when accurate low ppm values are required.



#### AMEVision display unit for 3050 series

AMEVision connects up to eight units, provides trend data, maintenance and troubleshooting information, and communicates via serial, Modbus, 4-20 mA, or Ethernet LAN. A verification or calibration can be initiated remotely as well.



### AMETEK ADVANTAGE

- Multiple sensor technologies ensures the proper performance fit for your application
- Proven QCM moisture analyzers deliver verified performance at low moisture concentrations
- TDLAS-based analyzers feature integral laser line-lock verification, delivering accurate measurements

### MEASURES: H<sub>2</sub>O

#### 5100HD

Moisture in natural gas stream concentration levels can be analyzed from ppm to percent. The measurement of moisture is not impacted by any amines, glycol, methanol, hydrogen sulfide (H<sub>2</sub>S) and/or methyl mercaptans present in the natural gas stream. To reduce maintenance requirements, each 5100HD includes a sealed reference cell to enable the ability to line-lock the laser, and an integrated sample conditioning system that removes any particulates or liquids.



## OXYGEN MEASUREMENT MONITORING IN VAPOR HEADSPACES

### Key considerations:

- Fast analysis of O<sub>2</sub> to immediately alert operations of a potential safety risk
- Accurate analysis of O<sub>2</sub> that is free of interference from the volatile components and water that may be present in the headspace
- Analyzer must comply with area safety requirements
- Minimal maintenance – keep workers out of the field

Oxygen (O<sub>2</sub>) measurement is typically carried out in the process line where the oil/water headspace is suctioned to one of two thermal oxidizers or flares. When O<sub>2</sub> level exceeds the safe limit of operation, a nitrogen purge of the tank headspace is initiated to keep O<sub>2</sub> at safe levels. By measuring the O<sub>2</sub> concentration in the headspace, nitrogen consumption can be optimized to keep the operating costs low while ensuring safe plant operation.

### AMETEK ADVANTAGE

- The 5100HD TDLAS responds to concentration changes in seconds versus minutes
- Integral laser line-lock verification system ensures the 5100HD is measuring the wavelengths (and components) of interest
- The 5100HD is certified for use in many hazardous locations, including those regulated by ATEX, CSA, IECEx, NEC and other agencies
- Using an Ethernet connection, the web-browser based software provides remote data and maintenance access

### PRODUCT SOLUTIONS

### MEASURES: O<sub>2</sub>, H<sub>2</sub>O

#### 5100HD

The 5100HD is an extractive type analyzer designed for hot/wet sample analysis. The 5100HD can be configured to analyze not only O<sub>2</sub>, but also H<sub>2</sub>S, H<sub>2</sub>O, carbon dioxide (CO<sub>2</sub>), carbon monoxide (CO), CH<sub>4</sub>, acetylene and many other small gas molecules. There is no sample conditioning required for the analyzer system other than particulate filtering and assuring the sample does not condense at the maximum integrated oven temperature of 150°C.

The model 5100HD uses a sealed reference cell containing the analyte gas for continuous on-line analyzer verification and offers high specificity, and sensitivity. The analyzer uses a completely digital implementation of the Wavelength Modulation Spectroscopy (WMS) approach, so changing the experimental protocol is simply a matter of uploading a file. The model 5100HD has been the choice of many customers as an alternative to paramagnetic-based O<sub>2</sub> analyzers in process tank headspace applications.



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## HYDROGEN SULFIDE IN REFINERY FUEL GAS

EPA regulation 40 CFR Part 60, sub part J, paragraph 60.105 requires the measurement of post-combustion hydrogen sulfide (H<sub>2</sub>S) in refinery fuel gas as a measure of the sulfur dioxide released to atmosphere in the combustion process. The 5100HD tunable diode laser absorption spectroscopy (TDLAS) analyzer directly measures the H<sub>2</sub>S concentration over the typical full-scale range of 0 to 300 parts per million (ppm). For process upset or flaring events, the 5100HD can also be configured with a second sample cell to measure sample streams that can contain up to 100% H<sub>2</sub>S.

### Key considerations:

- High reliability due to long life cycle of solid state lasers
- High specificity for H<sub>2</sub>S as an analyte
- 5100HD TDLAS analyzers are suited to refinery process conditions
- Significant savings using a TDLAS analyzer over a Process Gas Chromatograph (PGC) for refinery fuel gas applications

### AMETEK ADVANTAGE

- Field-proven on subpart J(a) H<sub>2</sub>S in flare gas applications (0 to 300 ppm)
- On-line verification (H<sub>2</sub>S reference cell) assures accurate results at low concentrations
- Direct measurement of H<sub>2</sub>S, no scrubber, no consumables
- Low maintenance: No carrier or hydrogen flame detector gases, no columns, no dilution, no switching
- Suitable for an ambient temperature range of -20 to 50 °C (-4 to +122°F)

## INTEGRATED SYSTEMS AND SHELTERS

To ensure accurate and reliable process measurements, a representative sample of the process fluid must be delivered to the analyzer. A well-designed sample conditioning system will consider filtration, temperature, pressure, flow rate and environmental conditions. Installations may require a full analyzer shelter including analyzers, sample systems, calibration gases, HVAC controls, and power distribution.

### Key considerations:

- Ensure representative sample of process fluid is delivered to analyzer
- Comply with all environmental, health, and safety requirements at the installation site.
- Optimize space constraints for both installation and service of analyzers
- Minimize analyzer maintenance while ensuring optimal performance

### AMETEK ADVANTAGE

- Proven track record in design and manufacture of sample systems and analyzer shelters
- In-house project engineering expertise from design to manufacture to factory acceptance testing
- Full after-sales support for installation and commissioning

## PRODUCT SOLUTIONS

### 5100HD

The 5100HD TDLAS uses a direct measurement technique, providing continuous H<sub>2</sub>S measurement quickly and accurately. Other "laser analyzer" manufacturers use scrubbing techniques to establish a zero background, that not only interrupts measurements for up to 20 minutes per hour, but also fails to address the fact that refinery fuel and flare gas hydrocarbon concentrations are frequently changing. To ensure the 5100HD continues to measure accurately, a sealed reference cell is integrated and a line-lock verification is constantly used. If required, the laser module can be changed in the field in less than one hour. Products from other TDLAS manufacturers must be returned to the factory for this type of repair.



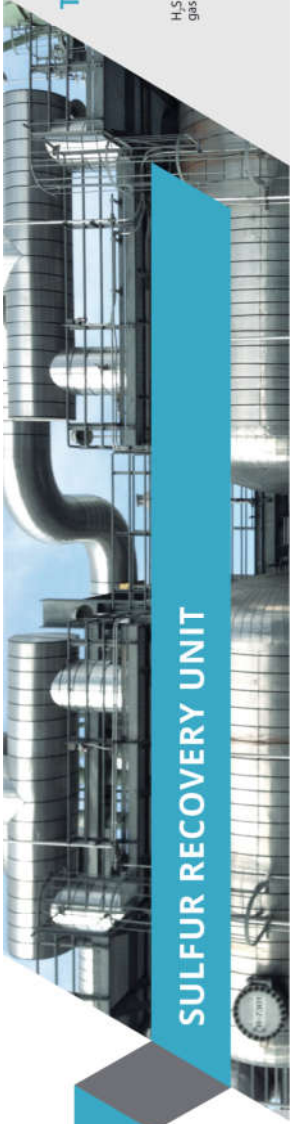
### MEASURES: H<sub>2</sub>S

## CABINETS, SHELTERS & HOUSES



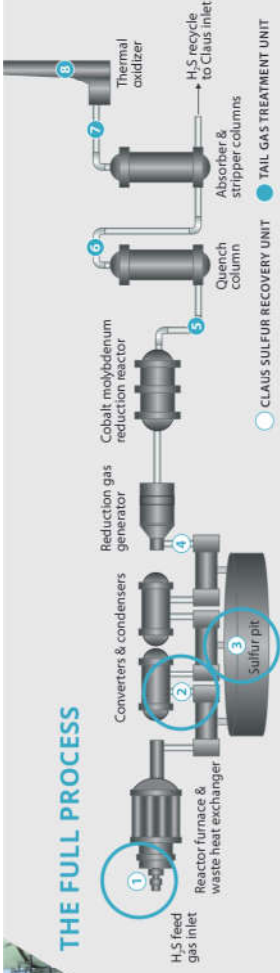
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## SULFUR RECOVERY UNIT

### THE FULL PROCESS



## 1. ACID FEED GAS

Sulfur recovery feed gas analysis has been widely applied using a variety of analytical techniques and combination of discrete analyzers to quantify the key components. What is required is a real-time (< 5-seconds) analysis of the important combustion components (ammonia (NH<sub>3</sub>), hydrocarbons and other optional organic compounds specific to the Claus reaction furnace chemistry).

Hydrocarbons (THC) are typically present in low concentrations, but are fast moving and have a significant combustion air requirement. Hydrogen sulfide (H<sub>2</sub>S) is the major component and is normally slow moving in terms of compositional change.

NH<sub>3</sub> is present in sour water stripper gas and has to be accounted for if present.

Carbon dioxide (CO<sub>2</sub>) is a relative minor contributor to air demand but can easily be included in the matrix analysis.

## 2. START-UP OXYGEN

During start-up and shut-down, any time a Sulfur Recovery Unit (SRU) transitions from ambient temperature through fuel gas warm-up to the introduction of acid gas, measurement of oxygen (O<sub>2</sub>) stoichiometry is critical. Historically, operators have manually taken samples using a portable electrochemical-type O<sub>2</sub> analyzer. While giving more or less satisfactory results, the requirement for more stringent operating limits, hazard exposure and the non-continuous nature are reasons to consider a permanent solution. A fixed system that draws a continuous sample during the operational transition period, without intervention from operations or analyzer maintenance, can be rationalized.

Paramagnetic analyzers have also been used to make this measurement but the technology is relatively fragile and the analyzers fail frequently. In contrast, tunable diode laser absorption spectroscopy lifetimes are typically in excess of ten years and there are no sensitive elements of the analyzer in contact with sample, a particular advantage in this application.

## MEASURES: H<sub>2</sub>S, Total HC, CO<sub>2</sub>, H<sub>2</sub>O, NH<sub>3</sub>

### IPS-4

In order to quantify all of these components a combination of ultraviolet (UV) and near-infrared (NIR) measurements are required. The AMETEK IPS-4 Dual Range Analyzer provides these capabilities in a single analyzer.



## MEASURES: O<sub>2</sub>, CO<sub>2</sub>

### 5100HD

End users that also want to measure carbon monoxide during start-up can do so when a second analytical bench is added to a 5100HD. Continuous NH<sub>3</sub> measurement is also possible with the 5100HD, after the reactor furnace or first condenser.



## 3. SULFUR PIT/TANK GAS

## MEASURES: H<sub>2</sub>S, SO<sub>2</sub>

In many sulfur recovery units, produced sulfur is stored in liquid form in sulfur pits. Operators are increasingly aware that sulfur pits present potential danger to plant personnel and overall plant safety. It is therefore critically important to monitor H<sub>2</sub>S in the vapor space of sulfur pits to ensure that it remains below the Lower Explosive Limit (LEL) (4.3% by volume). Additionally, the presence of rising concentrations of sulfur dioxide (SO<sub>2</sub>) in the sulfur pit vapor space provides an early indication of smoldering fires. Therefore, on-line, continuous monitoring of SO<sub>2</sub> can enable detection of such fires before they get out of control.

### 888 Sulfur Pit

Measures H<sub>2</sub>S in the vapor space above the sulfur pit at the measurement point, eliminating the need for expensive sample lines or environmentally controlled shelters. Substantial cost savings are recognized, while the safety critical measurement of H<sub>2</sub>S is performed continuously and accurately. SO<sub>2</sub> is simultaneously analyzed in the 0-1% concentration range, for customers requiring this measurement.



### 930 H<sub>2</sub>S

Field-proven as one of the industry's most reliable instruments for monitoring H<sub>2</sub>S and SO<sub>2</sub>, where a remote mounted analyzer is desired, the 930 uses AMETEK proprietary high-resolution UV technology in a dual beam, multiple wavelength configuration. Resolution better than 0.02 nm is provided by high intensity, line source lamps.

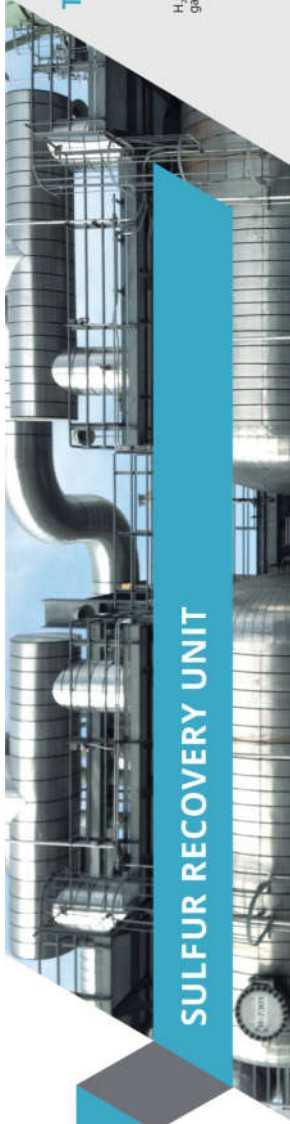
The unit samples the vapor space gas using proven ASR Probe technology. The sampling system has a sulfur knockout at the probe to eliminate entry of excess sulfur vapor or liquid into the system. The sample is then transported through an electrically traced sample line.



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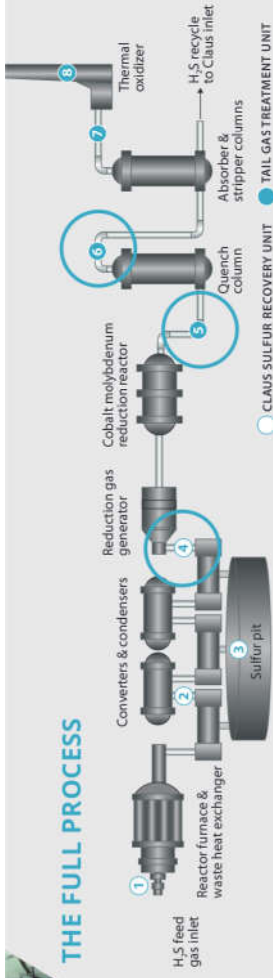
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## SULFUR RECOVERY UNIT

### THE FULL PROCESS



## 4. TAIL GAS

MEASURES:  $H_2S$ ,  $SO_2$ ,  $CO$ ,  $CS_2$

The primary online analytical measurement in the Claus sulfur recovery processes is hydrogen sulfide ( $H_2S$ )/sulfur dioxide ( $SO_2$ ) in the tail gas for 'trim air control' of the air to acid gas ratio. AMETEK has an installed base of over 2,000 active tail gas analyzers based on two distinct types. The close-coupled (no sample line) 888 mounts directly on the pipe and does not require a climate-controlled shelter. The 900 ADA, an extractive (sample line) type for installation in an analyzer house should be used in extreme climates or if the sample point location is compromised due to piping design.

### 888

The successor of the 880-NSL uses field-proven and highly reliable UV technology to accurately monitor the  $H_2S$  and  $SO_2$  concentrations in sulfur recovery tail gas without expensive sample lines or an environmentally controlled shelter. This compact, rugged analyzer mounts directly on the process pipe, eliminating the complexity and safety issues of fiber optic coupled photometers.



## 5. TGTU REACTOR OUTLET

MEASURES:  $SO_2$ ,  $H_2$

### 931

Uses AMETEK's proprietary high-resolution UV technology in a dual-beam, dual-wavelength configuration and no-moving-parts design. Instead of using a filter/chopper wheel to alternate between measure and reference wavelengths, the 931 uses a fixed optical configuration and pulsed ultraviolet (UV) lamps. This design leads to increased light throughput, reduced noise levels, and reduced maintenance. The dual-beam configuration, combined with the reference measurement, ensures low noise performance with minimal baseline and span drift.

The analyzer requirements are to measure residual hydrogen ( $H_2$ ) at the outlet of the reduction reactor as well as the  $SO_2$  at the inlet of the quench tower. The  $H_2$  measurement is to maintain excess  $H_2$  after the reduction reactor, typically 2 to 4%, which ensures complete reduction of  $SO_2$  to  $H_2S$ . Insufficient  $H_2$  causes  $SO_2$  breakthrough to the amine solvent which will react to form heat-stable salts and degrade the amine. The 931/932 analyzers are used to measure  $SO_2$  and  $H_2$  after the reduction reactor.



## 6. TGTU ABSORBER INLET

MEASURES:  $H_2S$ ,  $H_2$

### 931

Uses AMETEK's proprietary high-resolution UV technology in a dual-beam, dual-wavelength configuration and no-moving-parts design. Instead of using a filter/chopper wheel to alternate between measure and reference wavelengths, the 931 uses a fixed optical configuration and pulsed UV lamps.

After cooling and quenching the off-gas from the reduction reactor, the  $H_2S$  is selectively absorbed from the tail gas by means of an amine solvent. The 931/932 analyzers are used to measure  $H_2$  and  $H_2S$  at the inlet to the absorber.

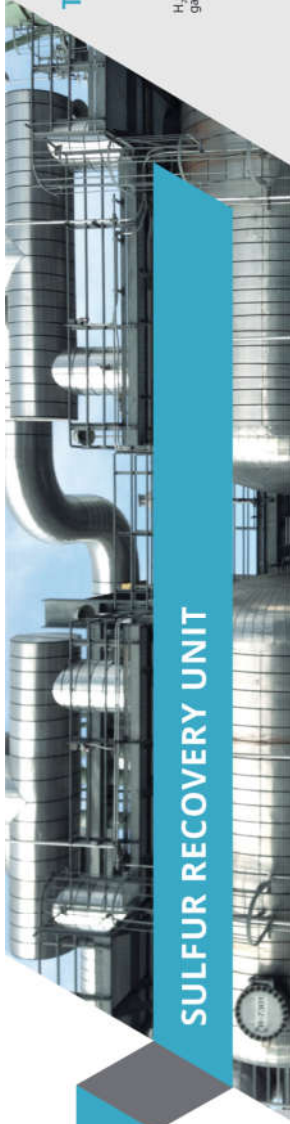


### 934

A rugged analyzer adapted from the 931/932 UV analyzer platform for measurement of  $H_2$  in Tail Gas Treatment Unit applications where the UV  $H_2S$  measurement is not required.

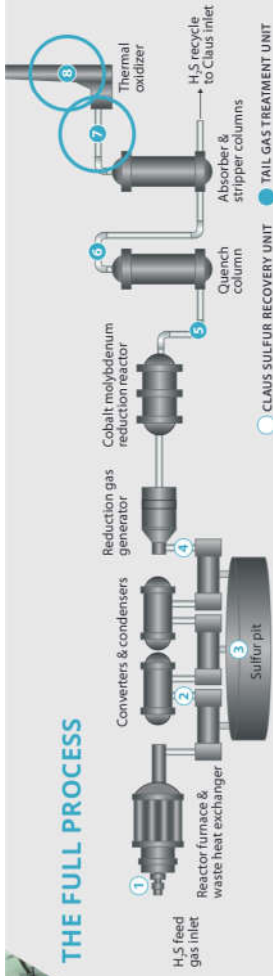


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## SULFUR RECOVERY UNIT

### THE FULL PROCESS



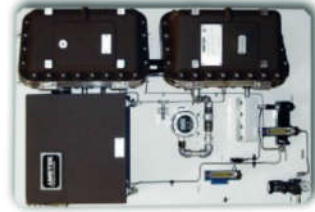
## 7. TGTU ABSORBER OUTLET

MEASURES: H<sub>2</sub>S, COS/CS<sub>2</sub>, H<sub>2</sub>

The off-gas from the top of the absorber column contains residual hydrogen (H<sub>2</sub>), hydrogen sulfide (H<sub>2</sub>S) and traces of carbonyl sulfide (COS)/carbon disulfide (CS<sub>2</sub>). Quantifying these components ensures the process is operating efficiently. The 931 and 932 analyzers can make these measurements on a continuous basis.

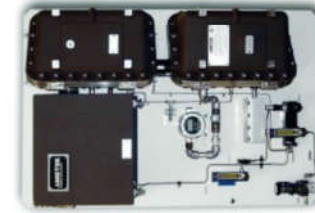
### 931

Uses AMETEK's proprietary high-resolution ultraviolet (UV) technology in a dual-beam, dual-wavelength configuration and no-moving-parts design. Instead of using a filter/chopper wheel to alternate between measure and reference wavelengths, the 931 uses a fixed optical configuration and pulsed UV lamps. This design leads to increased light throughput, reduced noise levels, and reduced maintenance. The dual-beam configuration, combined with the reference measurement, ensures low noise performance with minimal baseline and span drift.



### 932

Similar to the 931 mentioned previously, the 932 uses AMETEK's proprietary high-resolution UV technology in a dual-beam design and incorporates a filter wheel that allows the measurement of COS and CS<sub>2</sub> in addition to the H<sub>2</sub>S. Up to five components can be simultaneously measured with the 932, providing valuable information to users focused on safety, operational excellence and environmental responsibility.



## 8. STACK GAS EMISSIONS

MEASURES: SO<sub>2</sub>, O<sub>2</sub>, NO<sub>x</sub>, MASS EMISSIONS

Sulfur dioxide (SO<sub>2</sub>) emission measurement from AMETEK can be made on a dry or wet basis with various measurement options:

- If the Sulfur Recovery Unit is followed by a Tail Gas Treatment Unit (TGTU) the measurement base is typically "dry" basis.
- If the TGTU can be bypassed, the SO<sub>2</sub> analyzer can be dual-ranged (0 to 500 parts per million/0 to 1% SO<sub>2</sub>).
- An oxidizer can be added to account for reduced sulfur compounds (H<sub>2</sub>S/COS/CS<sub>2</sub>).

### 9900RM

Rack Mount dry gas SO<sub>2</sub> (SO<sub>2</sub>/NO<sub>x</sub>) analyzer. Capable of single-digit direct measurement of SO<sub>2</sub> and up to 200:1 dual-range capability. Wall mount option available.



### 919, 920, 909 & 910

Hot-wet analysis of SO<sub>2</sub> (SO<sub>2</sub>/NO<sub>x</sub>) for Mass Emission measurement or high-water high-acid-dew-point-samples. The 909 (single gas) and 910 (multiple gases) are specifically configured for monitoring stack emissions on a mass rate basis. They measure stack effluent temperature and velocity in addition to pollutant concentration at stack conditions, enabling mass emission rates to be reported. With the addition of an optional zirconium oxide sensor, each analyzer is capable of monitoring oxygen. The 919 (single gas) and 920 (multiple gases) do not include flow measurement.



### 914

The Continuous Emission Monitor (CEM) uses dry extractive sampling techniques designed to meet government regulations for all types of compliance monitoring.



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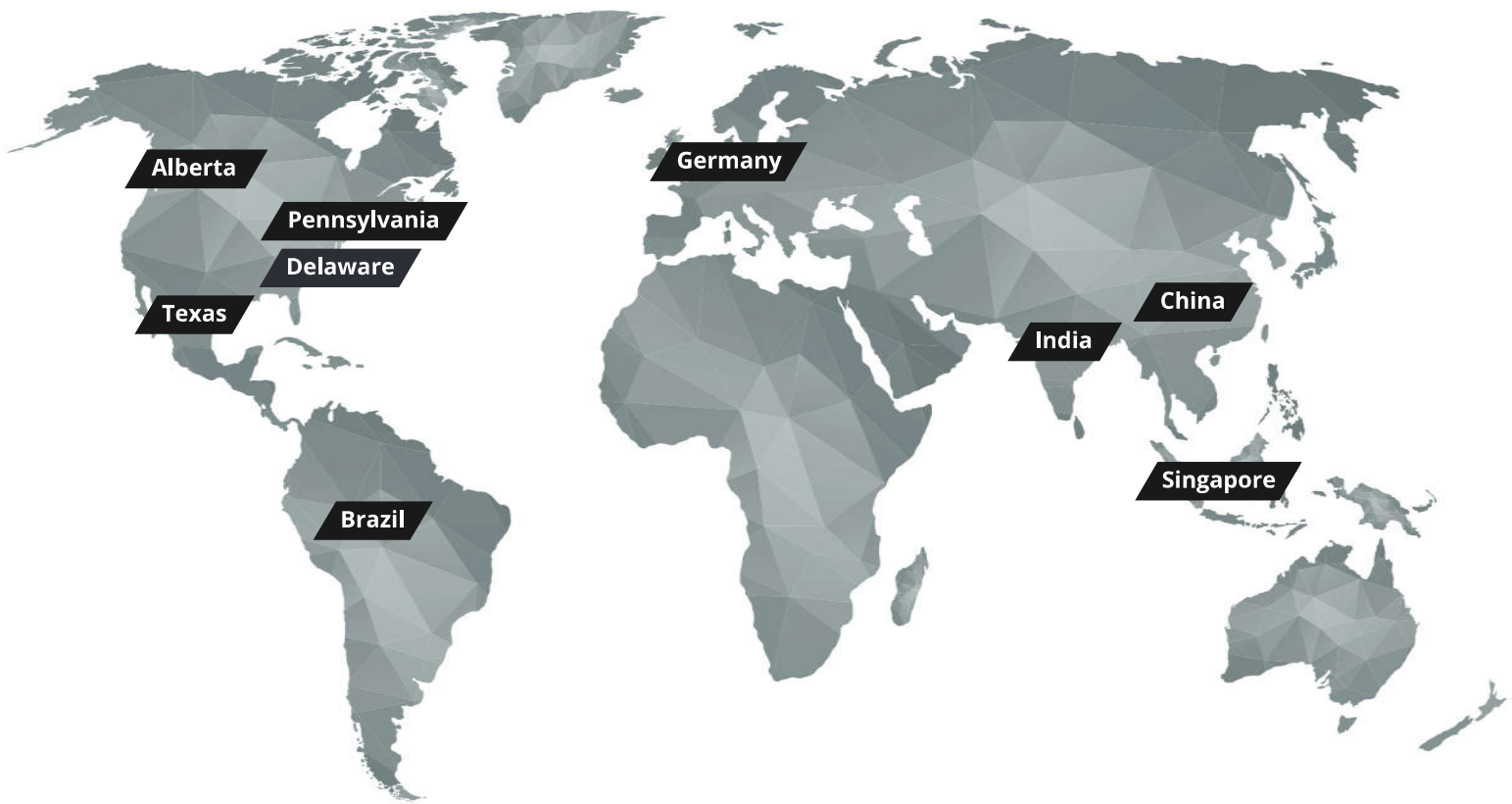
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