

HF Alkylation Process Acid Analyzer



Configuration

The HF Alkylation Process Acid Analyzer System consists of:

- Analyzer
 - Includes spectrometer, PC, monitor, keyboard, mouse, temperature controller for sampling system cell enclosure, I/O modules, power supply, optional air-conditioner
 - Complies with CE Mark and CSA
 - For general purpose environment
- Sample Handling System
 - Consists of fast-loop panel, fiber-optic transmission cell, temperature-controlled cell enclosure, optional HF gas sensor mounted on cell enclosure, automated fast-loop isolation valves, sample shut-off valve, beacon light, fiber-optic and electrical junction boxes
 - Suitable for Class 1, Division 2, Groups C & D & ATEX Zone 1 usage

Analyzer

- NEMA 12 cabinet 69.2 x 24.5 x 32.4 in. (175.8 x 62.1 x 82.4 cm) with forced air circulation (32-90°F, 0-30°C)
- NEMA 12 cabinet with optional air-conditioning (32-122°F, 0-50°C), to be used when the ambient temperature exceeds 86°F (30°C) or fluctuates by more than ±9°F (±5°C)
- Analyzer weight 290 lbs (132 kg), plus an additional 140 lbs (64 kg) for optional air conditioner
- FT-NIR covering the range from 4000 to 12000 cm⁻¹
- SMA-905 fiber-optic connections for 300 μm diameter fiber-optic cable
- Single fiber-optic output channel, expandable up to 8 output channels
- Single fiber-optic input channel, integrated room-temperature InGaAs detector with

variable-gain amplifier, expandable up to 8 input channels

- User-replaceable quartz halogen light source
- Ethernet link to dedicated network interface card on PC
- 19-inch rack-mounted industrial PC
- 15-inch flat screen color monitor
- Pull-out drawer with keyboard and mouse
- CANbus I/O modules and power supply
- Optional Modbus, OPC over Ethernet, or VistaNET communications
- Temperature controller for sampling system cell enclosure

Sample Handling System

- Sample handling system weight: 1160 lbs (526 kg)
- Construction Materials:
 - Standard configuration: All wetted metal parts Monel, unless explicitly stated
 - Optional Hastelloy-C configuration: All wetted metal parts Hastelloy-C (in normal sample flow), unless explicitly stated
 - All seals Teflon[®] or Kalrez[®], unless explicitly stated
 - Fiber-optic transmission cell windows constructed of sapphire
- Fast-loop Panel:
 - HF stream fast-loop constructed of 3/8" tubing and manual isolation valves
 - Pneumatically-controlled automatic isolation valves (activated by DCS, triggered by gas alarm) on sample input and output stream
 - Hastelloy-C flow meter (17-170 gal/hr) and needle valve to control the fast loop flow rate

Specifications

- Hastelloy-C Swirlklean™ filter, with 1/4" slip-stream going to fiber-optic transmission cell
- Manual isolation valves, check-valves and pressure regulators
- Isobutane input, nitrogen input, and blow-down output for flushing and maintenance
- Optional Hastelloy-C eductor (remotely located) connected to sample stream output for drawing sample through sampling system, NTP thread
- Fiber-Optic Transmission Cell Enclosure:
 - Temperature-controlled, insulated, NEMA 4X enclosure, controlled to 30.0±1.0°C (90.0±2.0°F), with see-through internal door
 - 1/4" sample slip-stream with 1 m coil before transmission cell for sample temperature equilibration
 - Fiber-optic, Hastelloy-C, near infrared transmission cell with 1.0 mm pathlength
 - Pneumatically-actuated, automatic, 1/4" sample shut-off valve to trap sample in cell during scanning period
 - Flow meter with low-flow contact and needle valve for controlling sample flow rate (0.24-1.27 gal/hr, 15-80 cc/min)
 - Nitrogen and acetone input (with quick-disconnect) and blow-down output for purging and cleaning the cell during maintenance and background reference acquisition
 - Membrane air dryer for continuous purge of fiber-optic transmission cell optics
 - Vortex cooler (90 psig, 15 scfm) in continuous operation with a 600 W heater (cycled duty) for controlling the temperature of the sample cell cabinet
 - Integrated 24 V HF gas sensor with 4-20 mA output to DCS for activation of beacon light and fast-loop isolation valves
- Fiber-Optic Junction Box:
 - NEMA 4X enclosure
 - 1 1/2" conduit (supplied by customer) connects to analyzer cabinet in general purpose environment contains 2 fiber optic cables, plus 1 or 2 recommended spares
- Two stainless-steel over-braided Teflon™ hoses connect fiber-optic junction box to transmission cell inside cell enclosure, each contains one fiber
- Liquid Jet Eductor:
 - Used for sample transport (supplied by customer)

Sample Requirements

- Fast-loop flow rate: 1 to 2 Gal/min (3.8 to 7.6 L/min)
- Sample temperature at fast loop: 68-104°F (20-40°C)
- Minimum pressure differential between input and output of sample handling system: 40 psig

I/O Format

- Hardwired
 - Digital input (typically volt-free contact)
 - Digital output (typically dry contact relay)
 - Analog input and output (typically 4-20 mA)
- Modbus
 - RS232 serial link (RS422/485 optional)
 - Modbus register address pattern: RTU protocol/Slave
 - Baud rate: default 19200 baud (configurable from 110 to 115200 baud)
- OPC
 - Ethernet link
 - Based on Microsoft's COM technology
- VistaNET
 - Ethernet link based Local Area Network for ABB process analyzers

Utilities and Services

- Analyzer
 - Power requirement for spectrometer, PC, and I/O modules: 115 VAC, 6 A, 12 AWG with ground
 - Power requirement for sample system heater: 115 VAC, 10 A, 10 AWG with ground
 - Power requirement for optional air conditioner: 115 VAC, 12 A, 12 AWG with ground

Analyze^{IT} Process FT-IR Spectrometer

- Operating temperature: 0 to 30°C
- Humidity: up to 95% non-condensing
- Fiber optic cables:
 - Maximum length (one way): 1650 feet (500 meters)
 - Minimum bending radius: 8 inches (18 cm)
 - Rigid conduit protection
- Communication access: independent analog phone line or Internet network connection for remote access to computer with modem for validation and service support
- Sample Handling System
 - The sample handling system consists of a Unistrut frame which can be bolted to concrete pad
 - Sunshade recommended (not supplied) for warmer climates
 - Power requirement for beacon light: 24 VDC (UPS)
 - Power requirement for isolation valve: 24 VDC (UPS)
 - Power requirement for HF gas sensor: 24 VDC (UPS)
 - Any piping connected to the sample handling system must be in accordance with the document "ConocoPhillips HF Service Piping Specification for NIR HF Analyzer Installation"
 - Any pumps connected to the sample handling system must be in accordance with the document "ConocoPhillips HF Service Specifications for Special Internal Seal Pumps"
 - Utility Requirements:
 - Blow-down output, 3/8" Swagelok, Monel, to be connected to a closed, atmospheric pressure, acid drain
 - Fast-loop input, 3/8" Swagelok, Monel, to be connected to sample tie-in location according to ConocoPhillips specifications
 - Fast-loop output, 3/8" Swagelok, Monel, to be connected to optional eductor, or other sample return location according to ConocoPhillips specifications
- Nitrogen cylinder for background reference acquisition, 20 psig, -40°F/C dew point, 2 scfm, 1/4" Swagelok, Monel, disconnect cylinder after each use, connection to plant nitrogen is not recommended
- Acetone container, pressurized with nitrogen to 20 psig, for cleaning transmission cell, if necessary
- Instrument air for vortex, clean, oil free, -20°C dew point, 90 psig, 15 scfm, 3/8" Swagelok, Monel
- Instrument air for membrane air dryer, clean, oil free, -20°C dew point, 50 psig, 0.175 scfm, Swagelok, Monel
- Isobutane wash stream for cleaning sampling system of HF, 1/4" Swagelok, Monel, can be connected to plant isobutane source
- Nitrogen cylinder for blow down of isobutane, 20 psig, -40°F/C dew point, 2 scfm, 1/4" Swagelok, Monel, disconnect cylinder after each use, connection to plant nitrogen is not recommended
- Discrete digital and analog signals are delivered as standard equipment with the analyzer system, however, Modbus or OPC over Ethernet can be used in addition to discrete IO
- Communications
 - 4-20 mA 24 VDC AO from HF gas sensor (to DCS)
 - 4-20 mA 24 VDC AO from analyzer for HF concentration (to DCS)
 - 4-20 mA 24 VDC AO from analyzer for ASO concentration (to DCS)
 - 4-20 mA 24 VDC AO from analyzer for H₂O concentration (to DCS)
 - 4-20 mA 24 VDC AI from temperature transmitter to temperature controller in analyzer cabinet
 - 4-20 mA 24 VDC AI from temperature controller to analyzer
 - Dry contact relay DO from analyzer for warning status (to DCS)
 - Dry contact relay DO from analyzer for alarm status (to DCS)

Analyze^{IT} Process FT-IR Spectrometer

- Dry contact relay DO from analyzer for fault status (to DCS)
- Dry contact relay DO from analyzer for online/offline status (to DCS)
- Dry contact relay DO from analyzer for low flow warning (to DCS)
- 24 VDC DO from analyzer for sample shut off valve activation (to sample shut-off valve)
- 24 VDC connection from DCS to sample handling system for HF beacon (red strobe) during gas sensor alarm
- 24 VDC connection from DCS to solenoid valve (NC) to isolate sampling system during gas sensor alarm
- 24 VDC intrinsically-safe DI from low-flow switch to analyzer

- Measurement interval: ~50 s
- Sampling: ~65 s sample flush time, followed by ~50 s stopped-flow scanning of sample
- Measurement frequency: all three measurements (HF, ASO, and H₂O) reported every ~2 minutes
- Range of analysis (w/w): HF 80-100%, ASO 0-20%, H₂O 0-5%
- Typical precision (for 50 s observation time): HF ±0.10%, ASO ±0.10%, H₂O ±0.03% (absolute scale, 95% confidence limits)
- Typical accuracy (agreement with laboratory method): HF ±3%, ASO ±3%, H₂O ±1% (absolute scale, 95% confidence limits)

Overall Dimensions (inches/mm)

	W	D	H
Rack-mount Enclosure	24.5/621	32.4/824	69.2/1758
Rack-mount Enclosure (with A/C)	24.5/621	32.4/824	80/2013
Sample Handling System	48/1219	25/635	75/1905

Calibration

- Pre-calibrated with global multivariate PLS calibrations for weight percentage of HF, ASO, and H₂O
- Adjustable slope and bias (if required) in accordance with validation strategy

Validation

Performance

- Spectrometric technique: Fourier Transform Near Infrared
- Resolution: 4 cm⁻¹
- Spectral range for measurement: 4,900 cm⁻¹ to 8,100 cm⁻¹
- Scan rate: ~38 scans/min

- Even though the ABB HF Alkylation Process Acid Analyzer provides results directly upon installation, each system requires a validation process for final acceptance.
- Internal validation of the calibration models is done by verifying that the Quality Index (F-Ratio) for each property does not exceed 4.0 over a 7-day period.
- The precision of measurement is confirmed by determining the standard deviation of 30 sequential sample measurements during a period of time when the process stream is relatively stable (ca. 1 hour). The measured standard deviation, multiplied by two (95% confidence limits) shall be less than the stated precision for that property (HF, ASO, or H₂O) to constitute validation and acceptance of the system.
- The accuracy of measurement is confirmed by determining the standard deviation of the difference between the analyzer and the laboratory measurement for 30 samples that have been pulled from the process. The measured standard deviation, multiplied by two (95% confidence limits), shall be less than the stated accuracy for that property (HF, ASO, or H₂O) to constitute validation and acceptance of the system.



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