HORIBA

PI-200-I Process Raman Multi-stream Analyzer

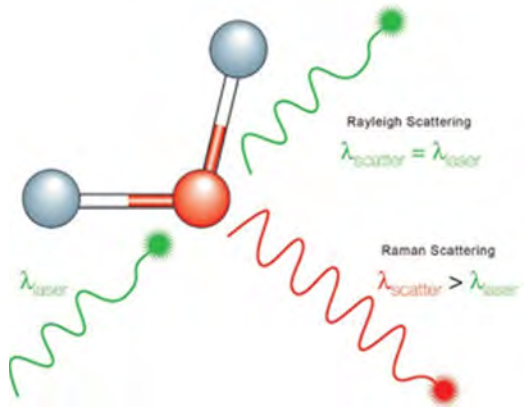
HORIBA process instruments

Process Raman Multi-stream Analysis with HORIBA Process Instruments

The HORIBA Process Instrument (PI)-200-I is a Raman Analyzer with 18 Channel Multiplex and designed to replace multiple other process analyzer by monitoring multiple components in up to 17 process streams. The analyzer generally requires no sample conditioning and can detect and quantify trace level amounts of key components within the process streams. The analyzer is packed in a General Purpose 19" rack or in a Purged Enclosure.

Why Process Raman

Raman spectroscopy is a vibrational technique involving high energy photons based on the inelastic scattering of radiation in the visible or near-infrared region. Most scattering (Rayleigh scatter) has the same wavelength as the laser source. Elastic scattering occurs when the photon frequency doesn't shift or change its wavelength. Inelastic scattering (Raman) the shift of the frequency can be used to get information about molecular chemistry.

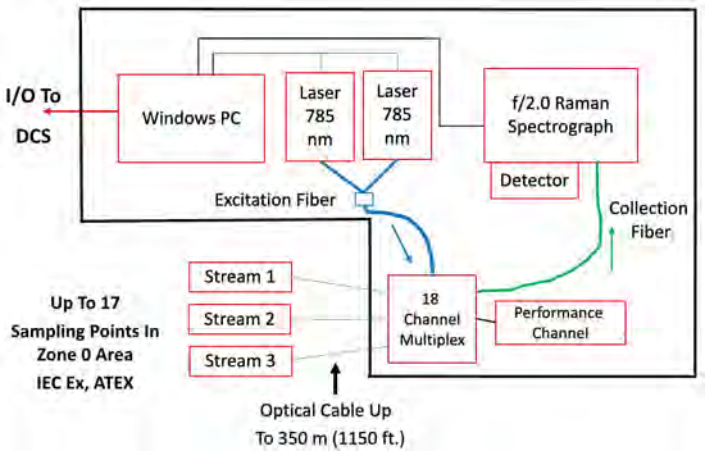


Raman bands result directly from molecular vibrations. These vibrations are very sensitive to changes in chemistry and structure. Each peak on the Raman spectrum corresponds with a different frequency of light absorbed by the sample which excited a vibration. These frequencies are unique to the molecule and the types of bonds it contains, the Raman spectra creates a "chemical fingerprint".

Process Raman spectroscopy has several advantages over other analytical techniques.

- Process Raman Spectroscopy:
  - Is ideally suited for liquid samples.
  - Can work with aqueous solutions.
  - Is a non-destructive technique that does not require any sample preparation.
  - Can differentiate chemical structures, even if they contain the same atoms in different arrangements.
  - Fewer spectral peaks increase calibration stability by reducing interferences.
- Raman spectra are acquired rapidly.
- Fiber optic cables for remote sampling.
- Flow cells or direct insertion probe.

Multi-stream Raman Analyzer

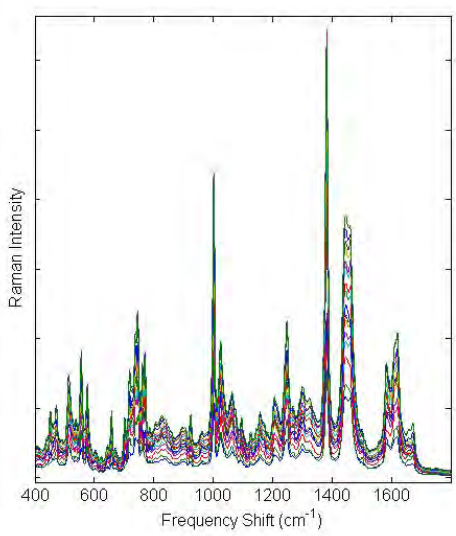


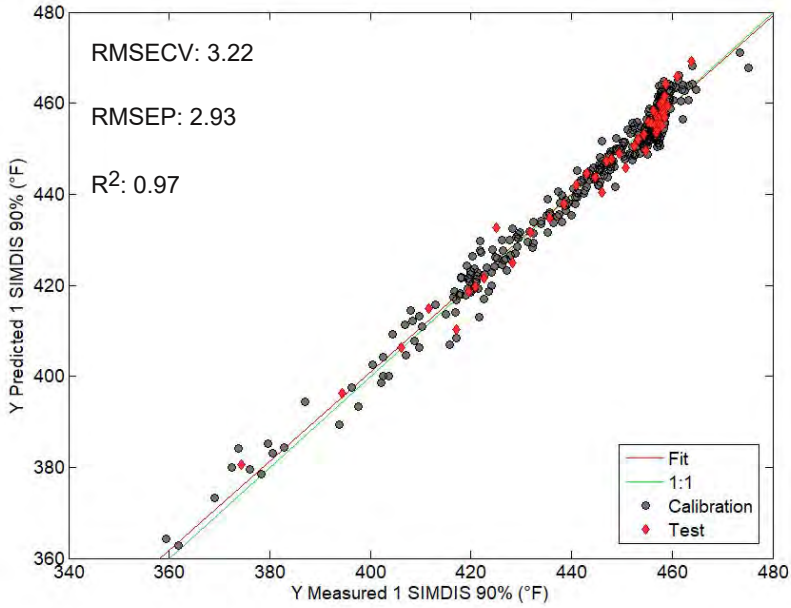
PI-200-I with Fiber Optic Couple PI Sample Enclosures

Chemometric Modeling

As a secondary method, the analyzer will depend for it's operation on developing calibrations that take spectra collected from standard process conditions and laboratory reference data. These tests typically follow ASTM guidelines to assure a certain level of consistency is followed during sampling and provide the user with a +/- margin of error. Calibrations models then model the primary methods and allowing the user with a single scan to predict multiple results at once. This decreases the routine testing frequency and provides realtime results as quickly as scans can be obtained.

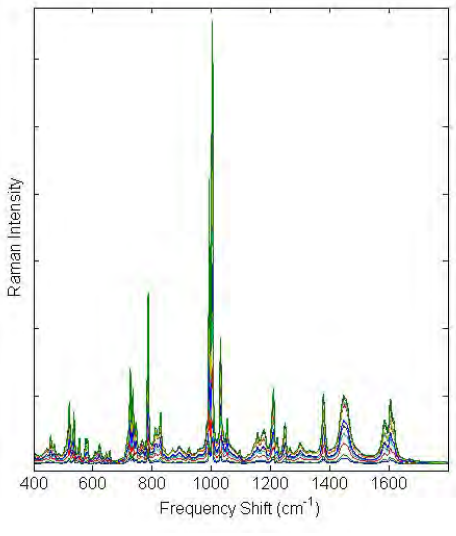
Performance Results

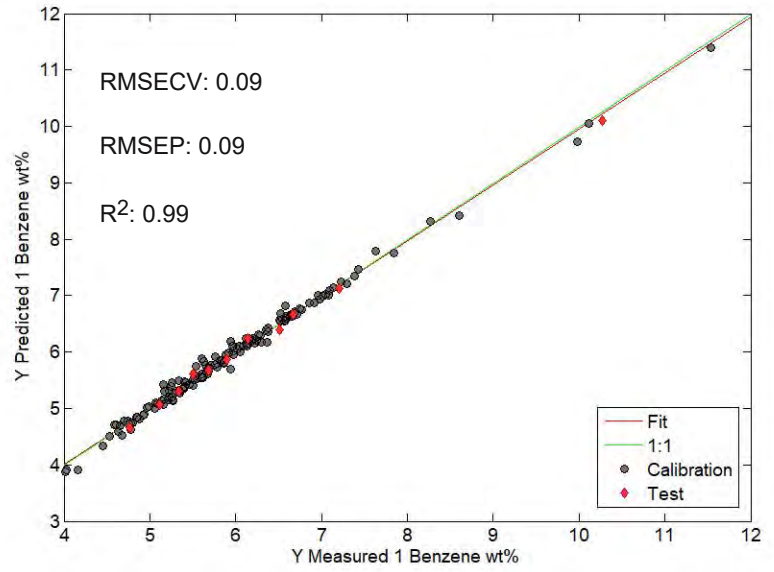




Cracked Naphtha

T90, defined as the 90%v evaporated temperature, is used to define volatility-related behavior in engines. This parameter is used to evaluate fuel composition effects on emissions. Key property for crude unit distallation and fractionation processes.





Reformate

Reformate serves as the primary supplier of aromatic bulk chemicals, including benzene, which finds diverse applications, notably as a key raw material for the production of plastics. Key property for environmental regulations and for control in chemical manufacturing.

The HORIBA's Process Instruments brand is specifically designed for industrial process-control and monitoring applications. HORIBA specializes in a providing a complete solution to address critical process control problems, which include collecting spectra from customers' samples, building the calibration models, and providing key model maintenance in order to maintain high predictive accuracy. Our ability to design excitation lasers for multiple wavelength allows HORIBA to asses which is best suited for an application in mind, in order to minimize the unwanted fluorescence effect.

Our patented laser (U.S. Patent No. 6,100,975), spectrograph (U.S. Patent No. 6,028,667), and 18-channel multiplexer (U.S. Patent No. 6,859,581) designs allow for robust, compact, and stable Raman instrumentation. These have been refined over the past 20 years to minimize energy losses therefore improving the limits of detection to below 100ppm with some compounds in the single digit range. The laser is optimized for fiber optics illumination and collection via a flow cell with sapphire windows. Collected radiation is returned to the monochromator with a fiber optics slit which is mated to holographic grating and 4-stage cooled CCD camera for detection. The HORIBA Process Instruments design is fast with minimum energy loss to maximize detection.

HORIBA unique features provide by Process Instruments:

- Real-time chemometrics with multiple parameter predictions.
- Redundant Lasers allow > 99.9% up time.
- Multiplexer allows monitoring up to 18 different streams.
- Laser power up to 1000 mW even in ATEX or IECEx applications.
- Automatic multi-point neon lamp wavelength calibration.
- Broad-spectrum white-light normalization to ensure chemometric model transfer.
- Automatic Wavelength tracking.
- System stability: ~ 0.010 cm^{-1} per month.
- SOLO and GRAMS compatible.
- 2-years standard warranty.
- First year Modeling included with ongoing Modeling Services and Training.

18-Channel Multiplexter

Liquid Sample

Specifications

- Spectrograph
  - Aperture: f/2.0
  - Focal lencth: 135 mm
  - Resolution: ~ 4cm^{-1}@ 785 nm excitation
  - CCD camera: Andor 1024 x 127 pixels, pixel size 26 µm
  - Camera cooling: 4-stage TE-cooling <-82°C
  - CCD chip is deep depleted and back illuminated for higher NIR-quantum efficiency
  - Ruled Grating with 1200 lines/mm.
  - Spectral coverage (adjustable): ~250 to 2650 cm^{-1} (785 nm excitation)
  - High performance, anti-reflection, aberration-corrected optics
  - Spectrograph, temperature controlled (~ 33°C) for added stability
  - Image curvature at exit plane < 0.5 pixel over full height of CCD array
- Multiplexer
  - Channels: 5, 9, or 18, note first channel used for toluene performance sample
  - Aerotech ¾ horse power servo motor using Soloist Motion Controller
  - Channel number 1 is set aside as a built-in performance monitor to check instrument performance hourly
  - Design life: > 20 years
  - On-demand sampling option allows control of multiplex with respect to Grab Sample collection location to ensure tight time stamp correlation with Lab data
- Laser
  - Redundant backup laser, with automatic switching
  - Power > 450 mW
  - 785 nm standard; other wavelengths available upon request
  - Laser life expectancy: > 4 years
- Calibration
  - Automatic for both x-axis and y-axis
  - Temperature control for Laser and Spectrograph
- Raman probe
  - Incorporating 10^{-8} Rayleigh filtering
  - Fiber coupling with slit array: 100 µm x 3.3 mm tall
  - Fiber optic probe lengths: Up to 1150 ft (350 m)
- Optical Fiber
  - Dual core, low OH, multimode, fibers (200-micron and 400-micron diameters) cable
  - Cable OD is 9.2 mm, fabricated with tough, LSZH Outer jacket with aramid yarn strength member
  - Dummy inserts for increased stiffness
  - Cable can be laid in cable tray or in conduit.
  - Cable is cut to length, terminated and tested at factory.
- Power requirements: On-line 10 amps
- Outputs available: TPC-IP, serial Modbus, and 4-20 mA
- Certifications:
  - Lasers CE, CDRH-certified, and EN60825-1
  - Analyzer ETL (UL-61010)
- Computer requirements: Windows Desktop PC or laptop

Applications

- Natural Gas Monitoring
- Crude Unit Monitoring
- LPG Monitoring
- Atmospheric Unit Monitoring
- Light Naphtha Isomerization
- Heavy Naphtha Octane loss
- Reformate Monitoring
- Benzene Reduction
- Aromatics Monitoring
- P-Xylene Monitoring
- FCC Monitoring
- Alkylation Process
- Reaction Monitoring
- Light Gases Fractionation
- Gasoline Blend Monitoring
- Mid and Heavy Distillate Monitoring
- Jet Fuel Monitoring
- Diesel Blend Monitoring
- Hydrocracking Monitoring
- Waterflood
- Sulfate Monitoring

PI-200 I Purged Enclosure

HORIBA Instruments Incorporated
9755 Research Dr, Irvine, CA 92618
info-pe.us@horiba.com |+1(800) 446-7422

HORIBA process instruments
630 Komas Dr #310, Salt Lake City, UT 84108
solutions@process-instruments-inc.com | (801) 322-1235
www.process-instruments-inc.com