Research-Cottrell
KVB/Analect

Analect Hydrocarbon SmartSystem™

Real-Time Octane Number and Composition Analysis for Refinery and Petrochemical Process Control

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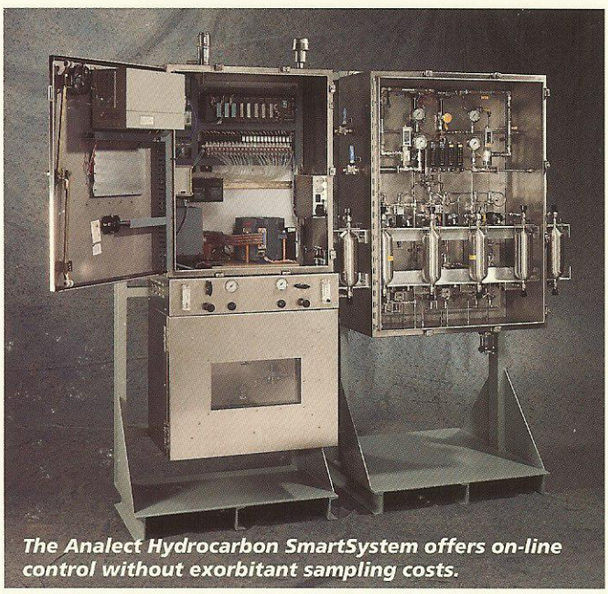

The Analect Hydrocarbon SmartSystem offers on-line control without exorbitant sampling costs.

On-Line RON/MON and Composition Measurements for Blending, Cracking, Catalytic Reforming, Alkylation Processes

If you had the ability to monitor changes in the octane number and composition of the product you are processing at this moment, you could:

- Determine gasoline or petrochemical process performance to improve your yield, feedstock and equipment usage
- Monitor blending to reduce giveaway, thus improving profitability
- Analyze product composition for consistency, quality and environmental compliance

Unfortunately, the multivariate nature of hydrocarbon stocks has severely limited the practical application of on-line infrared (IR) monitoring techniques in the hydrocarbon process industry.

That is, until now. Announcing a new on-line system that is changing hydrocarbon process monitoring:

New Exxon technology licensed to Analect

The new Analect Hydrocarbon SmartSystem is a real-time analyzer offering hydrocarbon processors the economic and safety advantages of on-line control without exorbitant sampling costs or the associated calibration problems. The system incorporates advanced technology that assures accurate readings under process conditions and facilitates calibration model upgrades.

Developed in two phases, the basic measurement concept, chemometrics calibration methods, and smart sampling system were conceived and demonstrated by Exxon Research and Engineering in a development program spanning several years. Exxon then came to the world leader in process FTIR systems, Analect FTIR, to translate this valuable research into an efficient on-line system.

Consequently, the analyzer's advanced chemometrics software, Constrained Principal Spectral Analysis™ (CPSA™), is patented by Exxon* with a patent applied for the associated smart sampling system. Both are licensed exclusively to KVB/Analect for the Analect Hydrocarbon SmartSystem.

In development, factory test, and on-line test for over two years, the integrated analyzer has been proven in monitoring octane and composition values accurately for up to six process streams with readings every two minutes. It archives all chemical composition information to meet current and future environmental regulations. Current analytical data can be sent directly into a process control computer or blending system to optimize manufacturing efficiency, and operation is made simple with industry-standard Microsoft-Windows software. Yet the Hydrocarbon SmartSystem costs less than a single-stream knock engine which produces only octane ratings once every eight minutes.

* U.S. Patent 5,121,337 (1992), Exxon Research & Engineering

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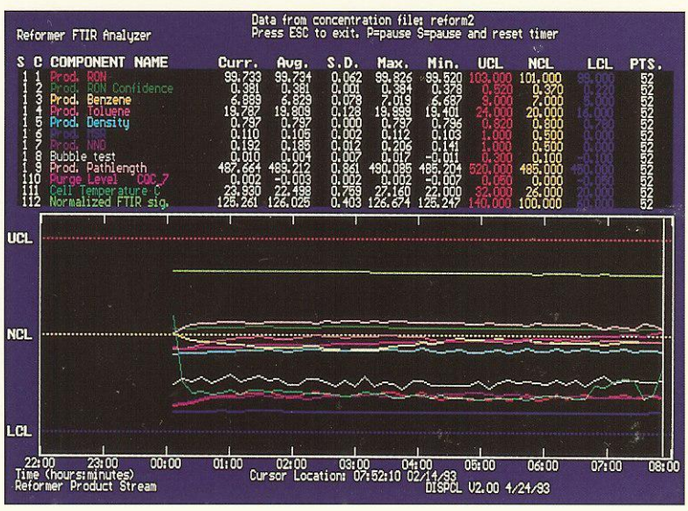
SmartSystem™ Masters the Art of Calibration Maintenance

It is effectively impossible to fully calibrate a real world hydrocarbon process stream in the laboratory given the industry's variable feedstock compositions, changes in processing conditions, and the flexibility required to inventory an assortment of products. Grab samples taken when an analyzer seems to be out of range or at predetermined intervals are only partially effective in refining the model. At best, calibration has come to depend on intuition as much as science; at worst, it can be an unproductive and time-consuming task.

Recognizing this need through its own hydrocarbon processing experience, Exxon created the SmartSystem, an automated, cutting-edge solution to frequent modeling problems. While the system's initial calibrations are completed in the laboratory, the unique samples inevitably encountered over time on the process line automatically are gathered and stored to assist in updating and expanding the calibration model. In addition, the advanced CPSA chemometrics developed in conjunction with Analect's process monitoring expertise allow the system to retain information, make judgements, and learn from previous experience in order to maximize calibration efficiency.



Sample Trend Chart - The analyzer continuously maintains a screen with plots measuring properties such as RON, Benzene and toluene; statistical data; and instrument performance factors, such as MSR, NND and pathlength. The example shown here is from an on-line system measuring a reformer output stream.

Process FTIR offers unsurpassed accuracy, ease of use

FTIR (Fourier Transform Infrared) is a non-invasive, exceptionally accurate monitoring technique that analyzes unknown samples using mid- and near-infrared absorption information. It is capable of more effective measurements in more process situations than any other technology.

Unlike traditional laboratory FTIR instruments, Analect systems are designed specifically to function amid the heat and vibration extremes of the process environment and have performed with trouble-free operation for over a decade. Our patented Transept® design features a moving wedge and fixed cube mirrors that replace the sensitive moving mirrors common in most systems. Analect process users generally report 99 percent or better system uptime with routine maintenance consisting only of a yearly light source replacement.

In addition, a number of features make FTIR particularly suited to process monitoring:

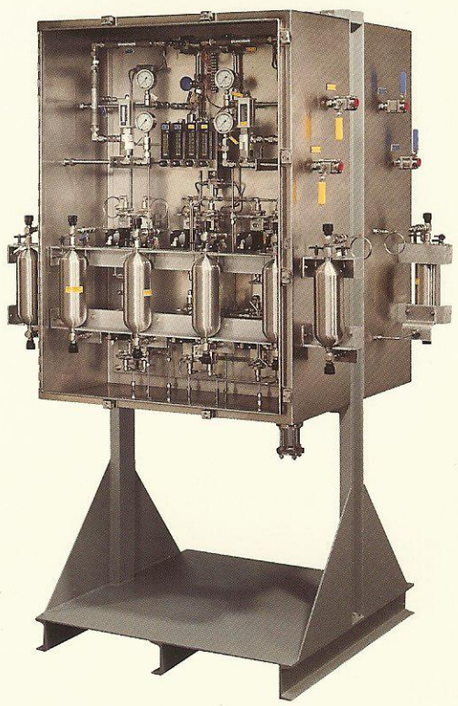
- All calibrations are permanent, since calibrations are ratiometric and are measured against the system's own background
- Laboratory models can be directly applied to systems on the process stream, since calibrations are transferable among similar instruments
- Our Analect PC-80 Software for Windows™ allows the system to continue monitoring indefinitely without operator intervention

How it works

Activity	Results
Gather & Characterize Reference Samples	*Properties & Spectra*
Build Startup CPSA Model	*Model*
Install On-Line System & Model	*Predicitions QC Data Statistics*
Harvest Unique Samples	*Samples Spectra Predictions*
Characterize Unique Samples	*Properties*
Update CPSA Model	*Improved Model*

In determining octane number and chemical composition, the Analect Hydrocarbon SmartSystem constantly compares each new sample to predetermined thresholds for three basic statistical parameters. Samples demonstrating unique statistical values are automatically saved in one of several sample bombs which a technician periodically removes along with sample spectra. The new samples are analyzed in the laboratory and the data used to update the model.

To eliminate long hours of analyzing samples which contribute little to a calibration, the SmartSystem has been configured to make value judgements regarding captured specimens, routinely weeding out samples that do not contribute to long-term model improvement. For example, the system might replace a sample with an Octane number of 101 with a new sample that exhibits a higher, more extreme reading. New spectra also are corrected for possible instrument drift so that only accurate information is added to the database.



The Analect SmartSystem automatically captures unique samples that can be incorporated into the calibration.

Constrained Principal Spectral Analysis (CPSA) compensates for inaccuracies

The chemometrics that make this possible are part of a new quantitative analysis program called Constrained Principal Spectral Analysis (CPSA) that is available with the Analect Hydrocarbon SmartSystem. A CPSA-processed calibration automatically compensates for the common instrument variations that can distort any analytical measurement.

In FTIR, these factors include the pathlength of the measurement cell; baseline offset, tilt or quadratic and cubic curvature; and interference from water vapor or carbon dioxide. Once these factors have been removed, the final spectral calibrations consist almost entirely of information reflecting true chemical differences. The corrected spectra are then processed with a conventional PCR algorithm.

Software fail-safe mechanism, reveals valuable information

The CPSA corrections also provide a fail-safe mechanism to monitor system performance and warn of impending problems that can be corrected before data is lost or compromised. A baseline offset might indicate a loss of system optical transmission, high H_2O or CO_2 denote purge problems, and changes in cell pathlength signal bubbles or coating problems in the cell. Any of these conditions can be easily corrected — with CPSA, detecting a potential problem before the process goes out of spec has just been made this simple.

A tabletop version of the analyzer is available for laboratory sample analysis.

Specifications

Hardware Configuration

- IBM-compatible 80486DX PC located either in the analyzer or a control room.
- Industrially-hardened, Transept-based FTIR process analyzer in NEMA enclosure, purged for operation in explosion hazard area. Includes the spectrometer, I/O subsystem, sample system pneumatic control, and system interconnection wiring. Sample cell is located in an attached NEMA which is purged separately.
- NEMA-enclosed SmartSystem with valving for up to six streams plus two calibration materials, and a manual sample bomb.

Software

- Microsoft Windows-based process monitoring software, Analect PC-80 Software for Windows™.
- Constrained Principal Spectral Analysis Software (CPSA).

Calibration Process

To develop an efficient and accurate custom calibration, samples are analyzed at your facility with a laboratory FTIR and flow cell for the 90-day period between order and delivery of an on-line system. These measurements are a negligible addition to your lab workload as FTIR readings generally are completed in less than 60 seconds, the software is automated and the sample volume minimal. Using the resulting spectra, a CPSA model can be built either by a chemist with calibration experience in your organization or by an applications chemist at our facilities. Additional calibration refinements from samples captured on-line can be incorporated into the model at your facility using an off-line 486DX PC or through Analect FTIR at a nominal cost per update.

The Analect Hydrocarbon SmartSystem™ Analyzer

- Provides a reading every two minutes, monitors up to 6 complex streams
- Recognizes and captures unique samples for future calibration model enhancement
- Incorporates patented chemometric software that corrects measurement variations from models, safeguards accuracy and reliability
- Calibrations are transferable directly from the lab to the factory floor
- Automatically archives all octane, compositional and statistical data
- Data is sent directly to process control computer or blending system for improved manufacturing efficiency
- Requires minimum maintenance, offers proven reliability
- Provides automated monitoring and industry-standard Microsoft Windows™ software

The AWT Family of Companies

Air & Water Technologies Corporation (AWT) is a fully integrated environmental treatment and services firm. Through subsidiaries Research-Cottrell and Metcalf & Eddy, AWT delivers the full range of pollution control equipment, services, and technologies important to the petrochemical industry.

A leader in the control of air toxics, NO_X, acid gases, particulate matter, fugitive emissions, and volatile organic compounds, Research-Cottrell also assists companies in meeting applicable regulatory requirements through emissions monitoring and database management services. Through Metcalf & Eddy, AWT offers crucial soil and groundwater remediation services and the treatment and disposal of toxic and hazardous wastes.

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Formerly Laser Precision Analytical/Analect FTIR.

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