Revolutionizing bioreactor control

Boosting efficiency with Raman technology and the Catalyx OpenBio® Biorector Controller

catalyx

Benefits at a glance

- Real-time efficiency
- Operational optimization
- Significant ROI
- Flexibility and adaptability
- Enhanced data integrity
- Versatile applications

Endress+Hauser's Raman probes (pictured) combined with Raman analyzers and the Catalyx OpenBio® Bioreactor Controller was a successful solution for one pharmaceutical company.

Summary: To enhance operational efficiency and precision, a pharmaceutical company has successfully integrated more than 30 Endress+Hauser Raman analyzers across multiple locations, including a site in Pennsylvania. This extensive deployment, with 10–15 analyzers dedicated to R&D and eight to manufacturing, highlights the transformative potential of Raman technology in diverse operational settings. They were integrated with Endress+Hauser's Rxn2 analyzers for the customer's lab and Rxn4 analyzer in the cGMP production area.

For more information about Catalyx, visit **www.catalyx.ai** or email **info@catalyx.ai**

Endress+Hauser
People for Process Automation

In addition, the company's bioreactor control platform was revolutionized by incorporating Raman data via Endress+Hauser's Raman Rxn-10 probes and the Catalyx OpenBio® Bioreactor Controller, making it more accessible and actionable. Using Catalyx's advanced process analytical technology (PAT) solution, the pharmaceutical company seamlessly integrated Raman data into its control platform, enabling real-time adjustments to feed rates. This innovation is crucial for optimizing cell growth conditions within bioreactors, ensuring that biological processes are consistently maintained at their optimal levels.

Challenge: The primary challenge for the pharmaceutical company was to enhance process efficiency for technicians and scientists. Traditionally, samples were manually extracted from vessels, analyzed in a lab and then used to adjust feed rates. This manual process was time-consuming and prone to contamination, which could compromise the integrity of the samples and the accuracy of the data obtained. The goal was to integrate systems to achieve real-time control, thereby improving operational efficiency and reducing the need for manual interventions.

Despite the clear benefits, the market has hesitated to implement such systems due to the associated costs and complexities. Bringing data into a usable platform is challenging for internal engineering teams, which adds to the apprehension. Furthermore, the absence of straightforward integration solutions has limited the number of companies that can effectively utilize this technology. Overcoming these integration challenges is essential for broader implementation.

Solution: The solution to these challenges for the pharmaceutical company rested in the Catalyx OpenBio® Bioreactor Controller platform provided by Catalyx in tandem with Endress+Hauser's Raman Rxn2 and Rxn4 analyzers and Rxn-10 probes. The Catalyx OpenBio® Bioreactor Controller integrates Raman analyzers and probes for continuous manufacturing. This platform improves efficiency and offers a substantial ROI, making it a valuable investment for companies looking to enhance their operational capabilities. For example, using Endress+Hauser's optical analysis measurement instruments and Catalyx's platform, the pharmaceutical company can now read glucose concentrations from a bioreactor and use this data to make immediate adjustments, ensuring optimal conditions for cell growth.

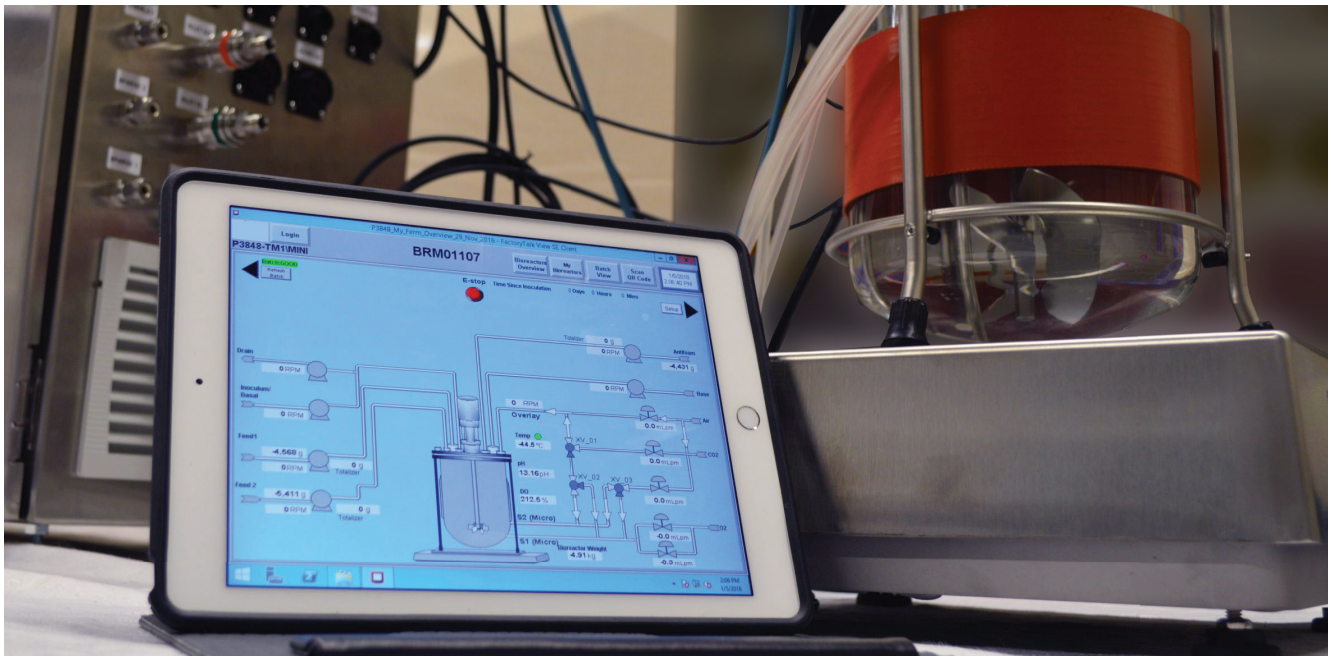
The Catalyx OpenBio® Bioreactor Controller is a high-functioning centerpiece for laboratory, process development and manufacturing operations. The technology allows recipes to run on any equipment within a network, including standard HMIs and mobile devices like tablets. Accuracy is ensured through automated routine processes, supporting recipe execution on smartphones, tablets and standalone HMIs.

Endress+Hauser's Raman Rxn4 analyzer with enclosure.

The system facilitates tech transfer between R&D and manufacturing, simplifying scale-up operations. Standard software with the capability to add specific algorithms enhances adaptability. The approach driven by S88 recipes and formulas provides greater batch control and increases data collection with a focus on data integrity. Comprehensive reporting and audit trails ensure transparency in processes.

The Raman Rxn2 analyzer from Endress+Hauser is a versatile tool designed for analytical laboratories, offering model transfer capabilities that make it indispensable for routine sample identification, R&D support, early process development and scale-up settings. Its portability, available as a benchtop or on a mobile wheeled cart, ensures convenience and flexibility in process development laboratories. The Raman Rxn2 excels in providing reliable real-time, in situ measurements, supported by intuitive embedded control software accessible via touchscreen or remote interface. This analyzer is particularly beneficial for chemical, pharmaceutical, biopharmaceutical and food and beverage applications, where it aids in polymerization, extrusion monitoring, reaction chemistry and bioprocess monitoring and control.

Furthermore, the Raman Rxn4 analyzer is tailored for manufacturing or process environments, delivering high-resolution performance for in situ, real-time measurement and control. Powered by Kaiser Raman technology, the Rxn4 features unique self-monitoring, diagnostics and self-calibration to ensure the validity of each measurement. Its stackable design in a standard 19-inch rack saves valuable space on the production floor,



Implementing the Catalyx OpenBio® Bioreactor Controller and the Raman analyzers and probes significantly improved operational efficiency by eliminating the need for manual sampling and reducing contamination risks.

and it is available with an optional stainless steel NEMA 4X enclosure for added durability. The Rxn4 is ideal for a wide range of applications, including chemical reaction monitoring, polymerization, API reaction monitoring and bioprocess monitoring, making it a robust, reliable and highly accurate solution for continuous process measurement and monitoring.

Holistically, the Raman Rxn-10 probe from Endress+Hauser is a versatile and high-performance probe designed for product and process development. It delivers reliable Raman measurements across a wide spectral range and is suitable for solids and liquids analysis. Compact, lightweight and flexible, the Raman Rxn-10 probe is ideal for various laboratory applications.

The Raman Rxn-10 probe accepts a variety of interchangeable optics, making it highly adaptable for different applications. It includes an integrated laser safety interlock with a “laser on” indication and probe shutter, ensuring safe operation. In addition to the life sciences industry, the probe is suitable for a wide range of industries, including chemical and food and beverage. The probe allows easy switching between non-contact, immersion and bioprocessing optics for each sector, providing flexibility for various measurement needs. It offers high sensitivity and access to the critical low-wavenumber region, enhancing the accuracy of measurements.

However, the solution’s flexibility extends beyond Raman technology as it can integrate other types of analytical data, such as Near-Infrared (NIR) spectroscopy. The backbone of this solution is OPC UA, a communication protocol that facilitates real-time data integration and control. This ensures the system can handle various data inputs and provide timely, accurate control responses. Integration with PAT software is a crucial aspect of the solution. The system is designed to work with various PAT software.

Results: Implementing the Catalyx OpenBio® Bioreactor Controller and the Raman analyzers and probes significantly improved operational efficiency by eliminating the need for manual sampling and reducing contamination risks. In addition, real-time monitoring and control allowed for more batches to be processed, reducing the batch time from seven to three days. This increase in efficiency maximized yields and the number of batches that could be processed, translating to an ROI of approximately $300,000 per unit per year.

Another critical aspect of the project was moving from merely monitoring to actively controlling processes with Raman analyzers and probes. This shift was exemplified by the pharmaceutical company using the technology for FDA-approved products at a manufacturing scale. This real-time control capability is crucial for optimizing production and ensuring consistent product quality. The project also emphasizes the harmonization of global efforts. By utilizing models and equipment from European sister sites, the team showcases the concept of “transferability of the model.” This means that successful processes can be replicated across different locations, ensuring consistency and efficiency in operations worldwide.

www.addresses.endress.com

CS01942L/24/EN/01.24-00
(11.24)

Endress+Hauser

People for Process Automation