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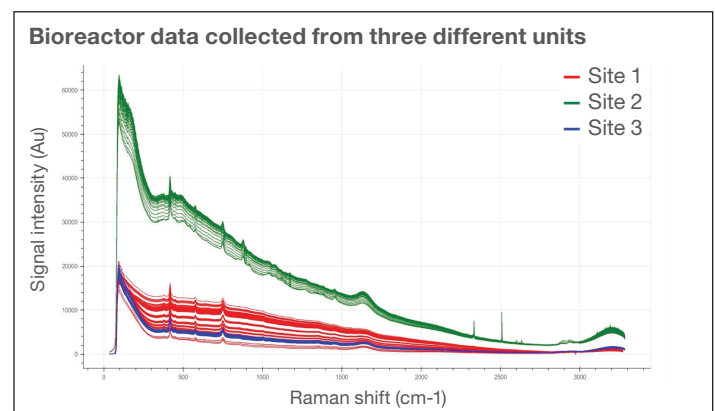
Raman process measurement

Using process Raman and data science to gain actionable information for glucose monitoring

Biopharmaceutical production requires a near-constant stream of compositional information to run efficiently. Solid-state process Raman is a proven technology for collecting that information while greatly reducing maintenance and operating costs compared to traditional physical sampling-based measurements. While the composition measurements are valuable to understand a bioprocess the end goal is to use this information for optimization and control. To realize this goal the compositional information can be processed using data science tools and packages that develop robust predictive models for key processes. Once these models have been developed and validated they can then be easily deployed to multiple Raman systems. Deploying the predictive models will provide actionable information, indicating when feeds or controls should be activated to optimize the bioprocess. This article will break down the simple process of building and applying quantitative Raman solutions to demonstrate how easy it is to add value with an all-in-one portable and scalable Raman system.

Creating a model for glucose

In biopharmaceutical production, cells require a feeding cycle of glucose to enable cell reproduction. The Thermo Scientific™

Ramina™ Process Analyzer leverages our compact and simplified hardware along with data science tools to model the glucose content of a bioprocess and tell you exactly when to add more glucose to ensure cell production at a precise rate.

Bioreactor data collected from three different units

— Site 1
— Site 2
— Site 3

Signal intensity (Au.)

Raman shift (cm-1)

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Global data for a global solution

Building this model begins with the process of collecting data. The data shown below comes from three data sets that were collected from different processes with different Ramina Process Analyzers from locations around the globe. Even so, a strong predictive glucose model was still built quickly. While the combined data looked quite messy at first, we were easily able to clean up the data and make all the information work well together. This was a relatively simple task due to the stability of the Ramina system, and the data science tools at hand. Once cleaned (pretreated), the data were combined and processed to build a "global" glucose model.

Preprocessed bioreactor data collected from three different units
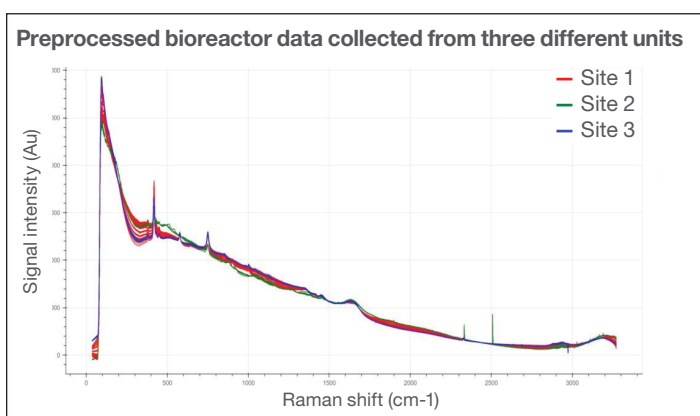
The power of preprocessing
The ease by which we can preprocess data comes largely from three key qualities of the Ramina Process Analyzer, its stability, reproducible sampling interface, and factory calibration. These qualities ensure that every Raman system is extremely stable, accurate, and consistent with other Ramina systems no matter the fleet location. From this foundation, we can leverage fundamental preprocessing methods that target and amplify the relevant signals within the Raman information. The result was a predictive model that delivers greater precision and accuracy across multiple Ramina Process Analyzer instruments.

Knowing when to feed your bioprocess with data science
After the predictive model has been made, it can be transferred to work with any Ramina Process Analyzer. We took our glucose model and applied it data outputs from a fourth Ramina system, where we can now track glucose concentration in real-time. You can see in the graph below; the spikes represent points at which the bioprocess has been fed more glucose. Over time, the glucose levels drop, and once a minimum value is reached, it is time to feed the bioprocess and ensure the process remains under control.

Data from a bioreactor processed through bioreactor model
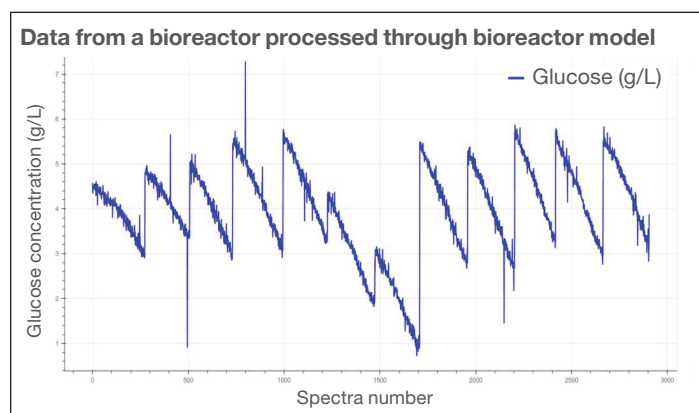
The solution we provide through the combination of our Ramina Process Analyzer hardware and data science tools enables companies to make actionable decisions to better manage their processes. Glucose monitoring is just one application where modeling can deliver a valuable solution.

Learn more at **thermofisher.com/ramina**

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