# ANALYTICAL AND DATA STRATEGY FOR CONTINUOUS DOWNSTREAM MANUFACTURING

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As advances emerge in developing continuous biomanufacturing processes, there is an increased need to deploy PAT tools to characterize, monitor, and control key quality attributes and a criticality to have a data infrastructure to support the immense amount of information being generated. While the desire for these tools exists in traditional batch processing, in a continuous operation, these become a requirement to ensure consistent product quality and enable proactive approaches in maintaining performance. The ultimate goal is to deploy PAT tools to reliably provide real-time information on product and process impurities throughout the entire operation. However, in its current state, there is a reliance on a mixture of inline, at-line, and offline technologies. By identifying the time criticality of CQAs, efforts can be focused on where to prioritize real-time measurements or instead, quicker or more automated testing for a subset of analytics. This work describes the application of this approach in the development of small-scale, compact in-line UV instruments to measure real-time protein concentration and in the integration of an automated sampling system with at-line and offline instrumentation for in-process impurity characterization.

Introduction of these PAT tools add to the complexity of the data infrastructure as it introduces requirements for platforms capable of supporting spectral data, chemometric model deployment, spectral instrument management, and time-alignment of discrete data. With the vast amount of information produced in a continuous environment, interface and analysis tools need to be developed so that any end-user can digest data into a format that easily allows them to gain insight into an ongoing batch. This work will highlight the data architecture of the continuous platform, with a focus on software tools selected for aggregation and real-time data visualization. The capabilities of these software packages were demonstrated through a proof-of-concept study using single-pass tangential flow filtration (SPTFF) as a model unit operation, which allowed integration of continuous, spectral, and discrete data. These tools allowed scientists to go from viewing real-time data across multiple, equipment-specific software to one consolidated interface, which in turn reduced time spent in compiling data for analysis and reporting. In addition, advanced capabilities of deploying model predictive control in SPTFF were demonstrated to show the application of a closed loop process control in continuous manufacturing.