

## **FROM N-1 TO PURIFIED PRODUCT IN A CLOSED AND CONNECTED SINGLE USE TECHNOLOGY PROCESS**

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Improvements in biopharmaceutical productivity and flexibility are achieved when unit operations in the production train perform in concert with each other. Achieving smooth interactions between unit operations requires combining single-use technology, hardware, automation, process design, and in-line process control.

Connected manufacturing refers to both physical and digital connections throughout the process of seamlessly linked unit operations through compatible physical connections. Each unit operation can be ready to anticipate and respond to fluctuations in process conditions leading to the ability to operate for the long processing times present in continuous processes. Preferably, connected manufacturing integrates an overarching layer of automation across multiple steps in the bioprocess train extending from upstream to downstream. Aligned with the physical connections, digital connections coordinate the individual unit operations with each other and minimize manual operations requiring operator intervention. Unit level automation and process level integration are critical to successful connected manufacturing.

Closed processes reduce the risk of contamination which can be magnified during the long processing times of continuous operations. Single-use technology is both an enabler and the preferred platform for closed process steps, especially the steps before viral inactivation.

This presentation describes the concepts of connecting a continuous upstream perfusion process to a closed and connected downstream process. In addition, two single-use compatible technologies were evaluated for the Protein A capture step: traditional columns in a pre-packed format and filter based adsorbers. We will show results from this closed and connected process starting at the N-1 step going all the way to the purified product. The results provide useful insights for biomanufacturers who are considering the value of connected processes. Furthermore, we will give insights about process design considerations, risks analysis, resource planning, buffer management and process automation.