

# Automating Media Preparation with In-Line Conditioning for Bioreactor Operations

A major biopharmaceutical company adopts in-line conditioning to achieve significant gains in efficiency and productivity.

## REMOVING INEFFICIENCIES IN MEDIA PREPARATION AND TRANSFER

At a major global biopharmaceutical manufacturing site, media preparation had become a limiting factor in upstream operations. The facility used both 1,000 L perfused stirred-tank bioreactors (STRs) and 200 L rocking bioreactors operated in fed batch and continuous mode.

Each production run required significant manual preparation and transfer:

- For the perfused STRs, 1,000 L of media per day were prepared in the media kitchen and transferred to storage tanks feeding the reactor over a 19-day production cycle.
- For the rocker bioreactor, 850 L of media was prepared in the media kitchen and transferred into a 500 L container feeding the reactor over a 7-day run.

These steps were time-consuming, labor-intensive and carried risks of human error and contamination. Use of mixers, holding tanks and transfer lines for media preparation created scheduling bottlenecks and operational inefficiencies.



## STREAMLINING OPERATIONS WITH IN-LINE CONDITIONING

To address these challenges, the customer sought to transition from undiluted to concentrated buffer and media formulations for both the STR and rocking bioreactor platforms.

By implementing Avantor's custom-built in-line conditioning system, concentrated buffers and media components could be automatically diluted to the required concentration and mixed just before delivery to the bioreactor. This approach delivered several benefits:

- Media preparation and transfer times were significantly reduced, freeing capacity for other critical production steps.
- Human errors were minimized, as the system automatically manages component dosing and mixing.
- Automated data capture and batch recording eliminated manual transcription, improving traceability and compliance.
- Equipment footprint and labor requirements were reduced, lowering the overall cost of goods.

## DESIGNING A PURPOSE-BUILT SOLUTION

Avantor® partnered with the customer to design and deliver a fully automated in-line conditioning skid capable of real-time preparation of precisely mixed media for the facility's bioreactors.

The system included:

- A custom stainless-steel skid with four peristaltic pumps for metered delivery of concentrated media components using single use flow kits.
- A surge tank and single-use static mixer assembly to ensure homogeneous blending of components.
- Integrated leak detection, load cells, and bubble sensors for process safety and reliability.

One challenge unique to this facility was its high-pressure water for injection (WFI) loop (6 bar), which exceeded the limits for single-use components. As part of the skid, Avantor engineered a stainless-steel brake tank to reduce the incoming pressure to atmospheric levels before introducing the WFI into the dilution stream.

The system was also equipped for clean-in-place (CIP) operations, with dedicated caustic and basic connections allowing the stainless-steel lines to be sanitized without disassembly, ensuring compliance with GMP requirements.

## INTEGRATING WITH EXISTING AUTOMATION AND ENSURING FUTURE SCALABILITY

The in-line conditioning skid was seamlessly integrated with the facility's automation platform. Avantor's engineering team developed detailed software and functional design specifications to define each process step, from valve actuation and pump control to flow verification and pH monitoring.

All operational parameters, including flow rates, pump speeds, pH, conductivity and system pressure, are continuously recorded and uploaded to the SCADA system. Data are automatically logged into the batch record, creating a complete trace of each run without manual data entry or laboratory testing.

The system incorporates multiple layers of process assurance, including leak detection and automatic system shutdown with operator alert. These safeguards reduce operator intervention and maintain process integrity, ensuring that each bioreactor receives accurately formulated, well-mixed media.

The new platform also enables future scalability, allowing additional concentrated buffers or media formulations to be incorporated with minimal hardware changes.

Overall, Avantor's tailored in-line conditioning solution transformed the customer's media preparation process, delivering automation, efficiency and data integrity across bioreactor operations.