FerroFlow: unlocking simulation software for Bioprocesses – control strategy for penicillin fermentation case study

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A persistent bottleneck in the biomanufacturing sector is the "scale-up gap," where laboratory-scale innovations fail to survive the transition to industrial production. While the chemical industry relies on rigorous platforms to design entire plants, the bioprocess industry has historically lacked the rigorous tools necessary to model complex biological libraries. To solve this, we introduce FerroFlow, a software-driven solution that brings industry-standard simulation to the world of biotechnology.

By embedding specialized biological modeling within Aveva Process Simulation (APS), FerroFlow enables users to perform high-fidelity mass and energy balances supported by APS's thermodynamic foundations. This integration allows engineers to evaluate plant configurations, determine precise equipment sizing and utility consumption, as well as techno-economic assessment (TEA) with the same degree of accuracy expected in modern chemical plants.

This presentation details a fermentation case study, implemented in APS and validated against full-scale industrial data. We demonstrate the platform's ability to size critical infrastructure, including:

- Fermenter sizing: Detailed impeller selection, gas-liquid mass transfer rates, and broth viscosity modeling.
- Mechanical Systems: Rigorous specification for air compressors, pumps, stirrers, and heat exchangers.
- Utility calculations: Precise calculation of electricity loads, power requirements, and cooling water cycles.
- Economic metrics: CAPEX, OPEX and TEA calculations

In this example, we also demonstrate the robustness of the tool by validating the feeding strategy, fermenter volume, mass and concentrations with industrial data. Different control strategies for oxygen supply, substrate, and vessel head pressure are also presented here.

By using the native "equation-oriented" architecture and validated sizing heuristics within APS, FerroFlow creates a fully integrated flowsheet that captures the nuances of a bioprocess in a way traditional chemical simulators cannot. While our current focus remains on fermentation, FerroFlow is actively expanding its downstream library, providing the standardized toolkit necessary to de-risk capital investment and optimize OPEX across the entire biomanufacturing lifecycle of a bioproduct.