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Simplifying Progress

Ambr® 250 HT Generation 2: A New Standard for Small Scale Bioreactors

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The New Ambr® 250 High Throughput Generation 2

The Ambr® 250 High Throughput Generation 2 sets a new standard for efficiency and precision in bioprocessing with improved scalability, data integrity, analytics, and user experience, marking significant progress in the process characterization capabilities of scale-down bioreactors. This poster demonstrates the impact of key new features on cell culture performance, as well as introduces the additional features that better facilitate process workflows.

Figure 1: *The new Ambr® 250 High Throughput Generation 2 system*

Figure 2: *Ambr® 250 bioreactor with integrated capacitance probe*

Advanced Gassing System

A major upgrade to the Ambr® 250 HT system is the implementation of mass flow controllers providing more efficient gas flow delivery with increased k_La, smoother gas flows, and tighter DO control.

Gen2 gassing system supports higher k_La

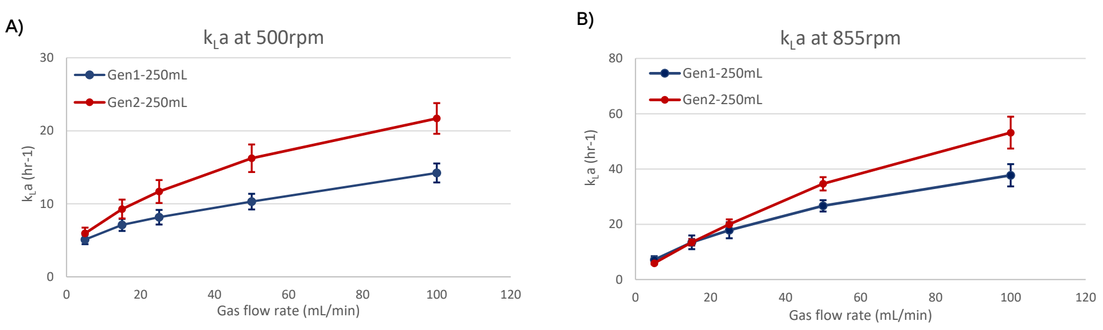

Figure 3: *k_La data with Ambr® 250 standard mammalian vessels using 1x PBS by gassing out method at (A) 500rpm and (B) 855rpm (n=20 Gen2, n=12 Gen1)*

Smoother DO control and gas flows

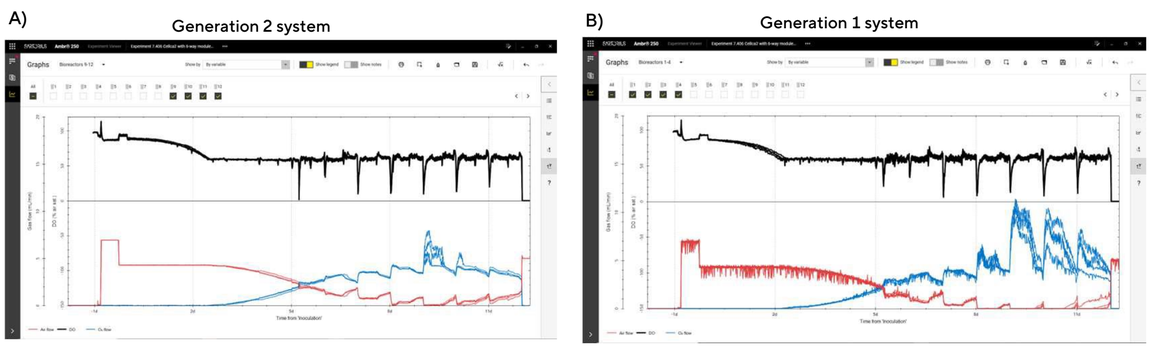

Figure 4: DO trends *(black), with air flow rate (red) and oxygen flow rate (blue) over the course of a fed-batch experiment on (A) Gen2 system and (B) Gen1 system. Smoother trends observed in Gen2 system, and lower oxygen demand due to higher kLa.*

CHO fed-batch cell culture growth and titer performance

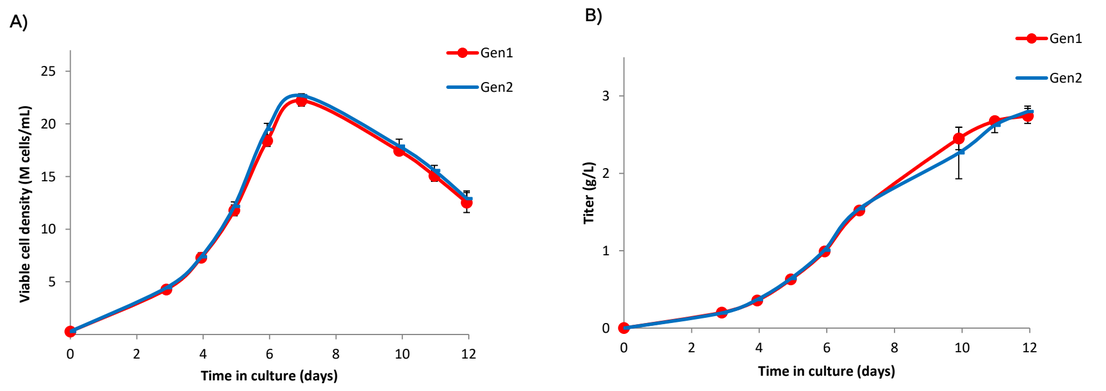

Figure 5: *Cell culture performance is unaffected in Gen2 system compared to Gen1 system for (A) viable cell density and (B) titer (n=4 Gen2, n=4 Gen1)*

Integrated Process Analytical Technologies

Newly integrated PAT sensors are introduced into the Ambr® 250 HT vessel, providing the capability to improve process control through continuous monitoring and the potential to trigger process events.

pCO_2 spot for continuous online monitoring of pCO_2 concentration in culture

pCO_2 levels in bioreactors can be continuously monitored for feedback control of CO_2 flows.

Figure 6 shows how the online sensor detects pCO_2 changes, due to sampling, feeding, or any other process events that offline analyzers often miss.

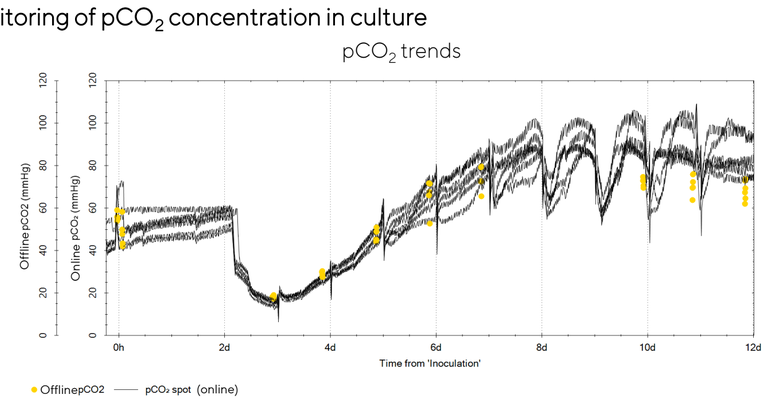

Figure 6: *Continuous trending for pCO_2 concentration with pCO_2 spot (black) provide insight into culture fluctuations between offline samples (yellow)*

BioPAT® Viamass capacitance probe for continuous online monitoring of viable cells

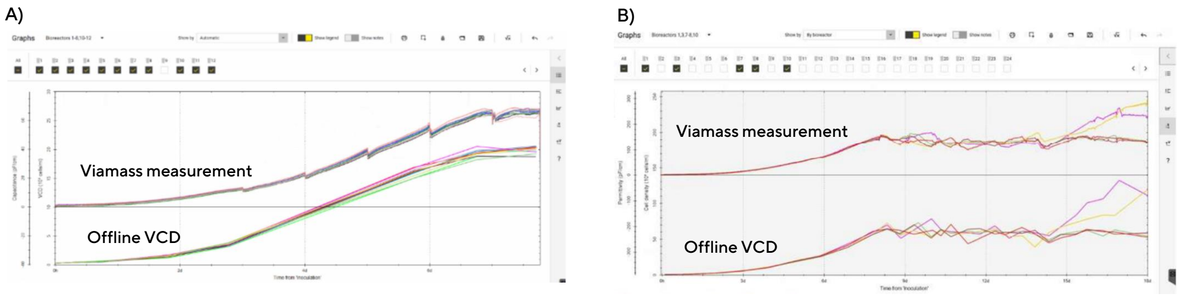

Figure 7: *Online trending of continuous BioPAT® Viamass measurements as visualized in Ambr® 250 software shows consistency with offline VCD data in both (A) fed-batch and (B) perfusion cultures. Precise measurement by the Viamass sensor detects fine detail of process, as evident in the dilution by daily feed additions in fed-batch culture.*

Sartorius BioPAT® Viamass technology has been implemented onto the Ambr® 250 HT Gen2 system, facilitating direct scaling with a single sensor technology in Sartorius bioreactors up to 2000L Biostat STR®.

Due to the flexible control architecture of the Ambr® 250 HT system, capacitance readings can be used for a wide range of process control actions, such as triggering events, parameter shifts, and controlling cell density in perfusion culture.

Figure 7 shows continuous capacitance readings alongside offline samples for both fed-batch and perfusion cultures.

Figure 8 shows good correlation between the Viamass reading and offline VCD across bioreactor scales, with an R^2 of 0.99.

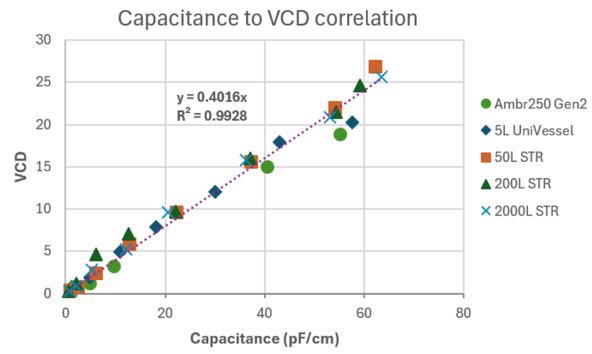

Figure 8: *Correlation between Viamass readings and offline VCD cell counts at bioreactor scales from Ambr® 250 up to 2000L STR*

Improved User Experience and Robustness

Live system surveillance with Vision System

System cameras enable remote visual monitoring, reducing out of hours lab visits and supporting faster interventions. Cameras are located on the liquid handler and at the top of the laminar flow cabinet, giving views of both the entire interior of the system and of specific liquid handler manipulations.

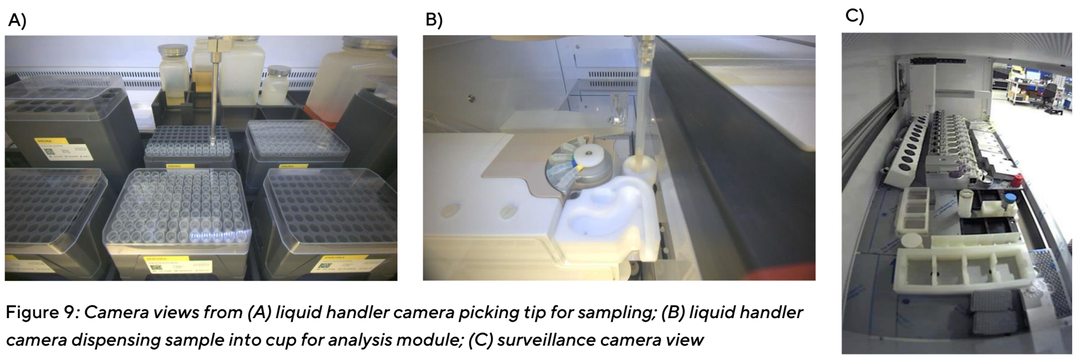

Figure 9*: Camera views from (A) liquid handler camera picking tip for sampling; (B) liquid handler camera dispensing sample into cup for analysis module; (C) surveillance camera view*

Quick access keypad

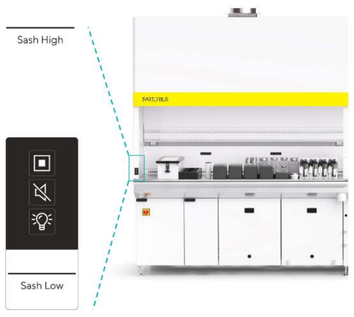

Figure 10: *An ergonomic keypad is positioned on the frame for quick system interactions*

Flexible tip bed & 1mL tips

Figure 11*: New 1mL tip replaces 300uL tip, allowing sampling from bioreactors; interchangeable with 10mL tip box on bed, providing location flexibility*

Improved tip bin

Figure 12: *A new tip bin box with absorbent pad better contains tip waste; box is easily removed for disposal, and stacks flat for efficient storage*

New User interface and Process Characterization features

The Ambr® 250 High Throughput Generation 2 software interface has been redesigned and further optimized according to the industry standard design guidelines (ISO 9241-210) to streamline user workflows.

Data integrity aspects have been improved with new features addressing user requests in several key areas:

- User log in and traceability
- Master processes
- Comparison of processes made simpler
- Audit process and configuration changes
- Tamper evident file format
- Unique sample identifiers

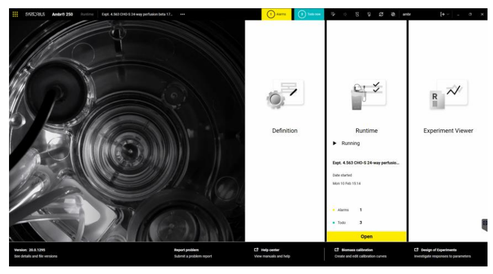

Figure 13: *Ambr® 250 HT Generation 2 User Interface*

Conclusion

The Ambr® 250 High Throughput Generation 2 system offers a robust, efficient, and scalable solution for the biopharmaceutical industry for late-stage process characterization. With integrated PAT tools, system enhancements, and expanded configurations, the Ambr® 250 provides increased process understanding and control for greater flexibility to support broader applications.

Acknowledgements

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