

Bioreactors

Bioreactor Systems

For Rapid Bioprocess Development

SMALL SCALE PROCESS
DEVELOPMENT

BioXplorer 400

CELL LINE / STRAIN
SCREENING

BioXplorer 100

LARGE CULTURE
VOLUMES

BioXplorer 5000



better chemistry – faster

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BioXplorer 100

Compact screening with high information content

The BioXplorer 100 is a high throughput, bioprocess screening system designed for fermentation working volumes of just 20 ml to 150 ml in blocks of 8 individually controlled bioreactors. Blocks can be combined to give an even larger number of parallel reactors.

- | Fully automated, high information content screening tool ideal for DOE studies
- | Most compact system for optimised use of bench space
- | Highly cost effective system for scalable, rapid, high throughput bioprocessing
- | Ideal for cell line/strain screening, media optimisation and small scale process development
- | Suitable for robotic integration
- | Choice of reactor sizes and types including elevated pressure design (5 bar or 10 bar options)



8 parallel reactors totally independent in temperature, stirring and all other process conditions



Glass and elevated pressure reactors



8 reactors, 20 ml to 150 ml working volumes

BioXplorer 400

Flexible, high data content optimisation

The BioXplorer 400 provides the ideal platform for bioprocess development and optimisation using 4 or 8 reactors in parallel with fermentation working volumes from 20 ml to 400 ml.

- | Most versatile bioprocessing platform for bioprocess development and optimisation
- | High information content and excellent scalability to large scale bioreactors
- | Reduce media costs and optimise the use of bench space
- | Optional elevated pressure design to 10 bar



4 or 8 parallel reactors totally independent in temperature, stirring and all other process conditions



Glass and elevated pressure reactors

4 or 8 reactors, 20 ml to 400 ml working volumes

BioXplorer 5000

Automated Bench Scale Bioreactors

The BioXplorer 5000 reactor range is designed to enable users to obtain a better understanding of their bioprocesses at bench scale. The entire range offers an easy-to-handle, customisable and upgradable system with interchangeable culture volumes from 0.5 L to 5 L.

The BioXplorer 5000 range is ideal for:

- | Microbial and mammalian cell culture and gas fermentation
- | Elevated pressure design optional
- | Process development and optimisation and scale-up studies



Elevated pressure bioreactor of enhanced gas transfer



Single or multiple (independent) reactors, range of interchangeable volumes 0.5 L to 5 L

Elevated Pressure Bioreactors for Improved Gas Transfer

It is widely recognised that low gas transfer rate is the major factor affecting bioprocess economics.

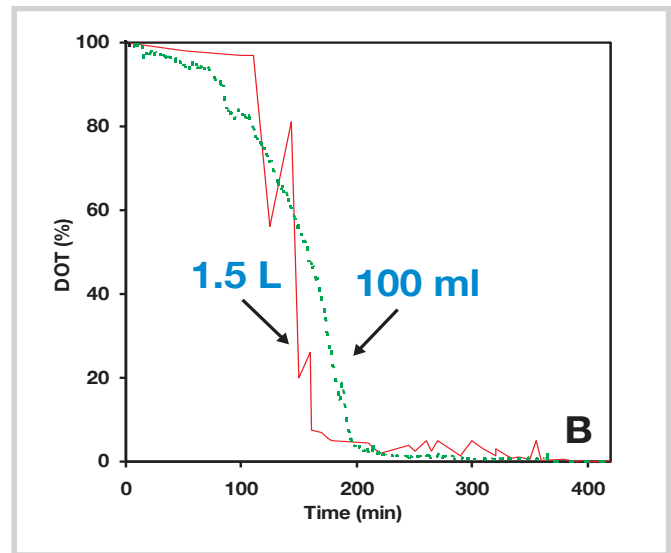
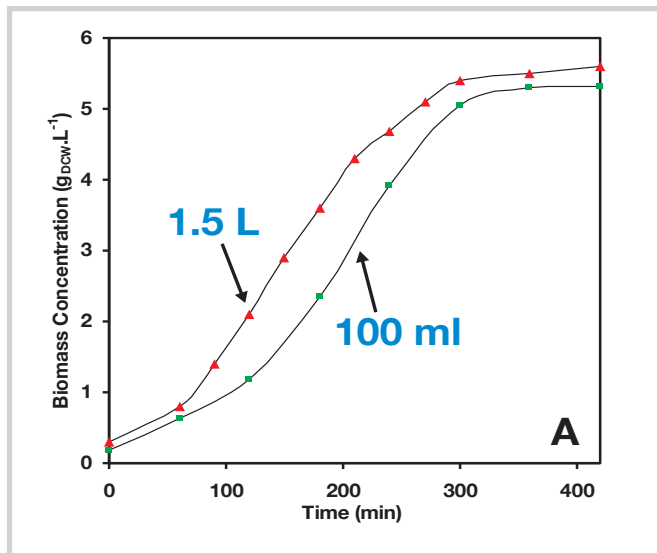
A possible solution lies in operation at elevated pressure. HEL is already providing bioreactors for pressure operation which offer these benefits:

- | Overcoming solubility limits in gas fermentation
- | Oxygen transfer enhancement in mammalian cell cultures
- | Pressure as an effective addition to agitation/sparging
- | Better understanding large bioreactor behaviour (where large pressure gradients normally exist)



Scalability

The key feature of the mini bioreactor design is to ensure the replication of results obtained using larger scale vessels. This is achieved through careful design of vessel geometry, agitation, excellent control of pH and the reliable monitoring of DO.



Proven, scalable performance using 100 ml and 1.5 L reactors. Above panel demonstrates values across reactors for biomass (left) and oxygen transfer (right)

BioVIS: Real-Time Cell Density and Biomass Monitoring

BioVIS allows the online monitoring of cell growth and biomass using optical density, which can reduce or replace the need for online sampling. This feature allows the user to track the growth and understand the processes without taking samples. Viable cell density probes can also be integrated.



Online Off-Gas Analysis and RQ Measurement

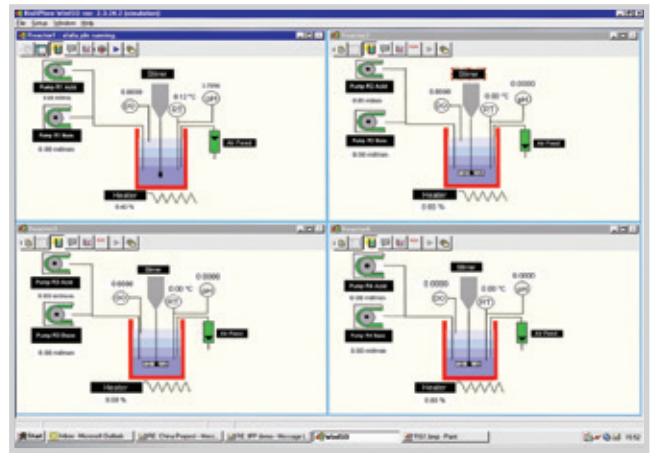
As part of the BioXplorer system, HEL offers a range of Tandem off-gas analysis units as an on-line tool to monitor and control a process continuously. By monitoring the off-gas, the software can automatically calculate the oxygen uptake rate (OUR) of the cultivated cells and the carbon dioxide production rate (CPR) can be measured for micro-organisms. From this data, the respiration quotient (RQ) can be calculated automatically.



Full Software Control

All parameters can be monitored/controlled including:

- | Temperature
- | Gas feeds, flow and mix
- | pH
- | Dissolved oxygen
- | Stirrer speed
- | Torque (for viscosity indication)
- | Pressure
- | Liquid feed rates
- | Antifoam and level detection



Aeration and DO Control

The BioXplorer series offers a range of simple and more sophisticated gas flow control regimes for simple gas addition to gas blending and mixing. Each bioreactor can be configured with single or multiple rotameters and/or mass flow controllers.

For microbial fermentations, automatic oxygen enrichment is possible if an air and oxygen (or enriched oxygen) source is supplied – the controller can be set to maintain a chosen dissolved oxygen (DO) value by altering the amount of supplied gas. In the case of cell culture applications, 2, 3 or 4 gases can be blended including CO₂ for pH control. Gases suited to bio-fuel applications can also be blended using the same method. Different spargers are available to meet specific requirements.



pH Control

For conventional microbial applications, peristaltic pumps are used to add acid/base, providing control to better than 0.05 pH units using an adaptive control method. Single or bi-directional control may be selected. The software records (and displays) the total amount of acid or base consumed. In other applications, such as cell cultures, pH is controlled by gas (CO₂) blending.



Stirring

The BioXplorer range offers a choice of stirring systems depending on the size of vessel and the application.

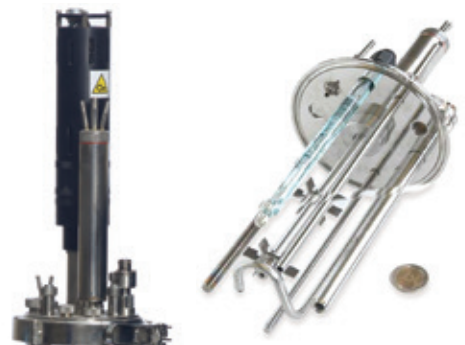
Magnetically Suspended Stirring

- | HEL's proprietary design is recommended for reactors up to 500 ml
- | Ideally suited to small bioreactors with proven performance
- | No shaft seal or moving parts: no sterility issues
- | Excellent magnetic coupling
- | Range of stirrer designs (marine, rushton, etc)
- | Speed 250 rpm to 1500 rpm



Agitation: Overhead Stirring

- | Overhead stirring is offered on vessels from 300 ml upwards and is commonly used for larger bench-scale reactors



Liquid Feeds

Highly linear peristaltic pump drives are integrated into standard heads (choice of different sizes) which enable exceptional pH and dosing control as well as a wide operating range. Typically, two to four pumps per reactor are supplied but additional pumps can be added as needed.



A more compact peristaltic/syringe based design is also available.

Specifications

	BioXplorer 100	BioXplorer 400	BioXplorer 5000
Parallel Bioreactors	8 or more	4 or more	1 or more
Vessels	Glass Stainless Steel	Glass Stainless Steel	Glass Stainless Steel
Working Volumes	20 ml to 150 ml	20 ml to 400 ml	400 ml to 5 L
Stirring Speed	250 rpm to 1500 rpm*	250 rpm to 1500 rpm*	50 rpm to 1500 rpm*
Impellers	Rushton Marine Pitched	Rushton Marine Pitched	Rushton Marine Pitched
Stirring Drive	Magnetic drive	Magnetic drive Overhead drive	Overhead drive
Temp. Range	-20 °C to 200 °C**	-20 °C to 200 °C**	-20 °C to 200 °C**
Temp. Control	Integrated, individual electrical heating in the block, software controlled	Integrated, individual electrical heating in the block, software controlled	Heated jacket or Circulator, software controlled
Applications	Mammalian Microbial Gas Fermentation	Mammalian Microbial Gas Fermentation	Mammalian Microbial Gas Fermentation
pH Control	Acid/base liquid feed; Gas addition	Acid/base liquid feed; Gas addition	Acid/base liquid feed
Liquid Feeds	Optional anti-foam; substrate feeds	Optional anti-foam; substrate feeds	Optional anti-foam; substrate feeds
OD Measurement	Optional	Optional	Optional
Gas Mixing	Air, N ₂ , O ₂ , CO, CH ₄ and CO ₂	Air, N ₂ , O ₂ , CO, CH ₄ and CO ₂	Air, N ₂ , O ₂ , CO, CH ₄ and CO ₂
Max Pressure	Up to 10 bar with stainless steel vessels	Up to 10 bar with stainless steel vessels	Atmospheric - 10 bar

*Speeds depend on stirrer drive, media properties and aeration rate.

**Sub-ambient cooling requires optional cooling module.

About HEL

HEL is an international company that specialises in chemical reactors, bioreactors and related data/logging tools for process R&D in the pharmaceutical, fine chemical, biotechnology and petrochemical industries. Established in 1987 and with clients worldwide our key strengths are:

Knowledgeable staff - highly qualified and experienced chemical engineers and chemists

Quality - underpinned by ISO9001 certification for over 16 years

Service - choice of service contracts backed by an established culture of unmatched client support

Range of products - both off-the-shelf and custom designs, manual and fully automated controls, low and high pressure/temperature applications, single and parallel/multi-vessel products

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