

# IKA

designed to work perfectly

EN



Bio  
Processing  
Solutions

## ESSENTIAL GUIDE TO BIOREACTORS

## The Role of Bioreactors in Modern Bioprocessing

Bioreactors are advanced equipment that are essential in modern biotechnology. They provide optimal environments for the growth of cells or microorganisms. Equipped with sensors and software, they control growth conditions, maintain optimal parameters, and improve efficiency, quality, and yields. They also enable the transfer of optimized conditions from the lab to industrial scale, allowing for the mass production of cells or cell-derived products.

IKA HABITAT Bioreactors offer outstanding features and benefits over traditional bioreactors in biological processes that optimize the quality of the final product and enable its scalability. In certain applications, this technology is indispensable, enabling contemporary biotechnological advancements beyond the reach of traditional methods.

## /// Critical Applications for Bioreactors in Modern Bioprocessing

Bioreactor applications work with two main types of organisms: mammalian/animal cells or microorganisms, such as bacteria, yeast, and fungi. Depending on the organism, the process is called fermentation for microbial cultures or cell culture for mammalian and animal cells.

### Cell Applications

Mammalian & Insect Cells

#### Protein Production

- › Cultured meat
- › Protein-based drugs
- › Products for diagnostic testing
- › Monoclonal antibodies
- › Enzymes

#### Cell Production

- › Extended preservation in biobanks
- › Mass cell production for diagnostic tests
- › Gene therapy
- › Regenerative medicine or research

#### Virus Production

- › Virus-based drugs (e.g. vaccines)

### Microorganism Applications

Bacteria, Fungi, Algae Cells

#### Protein Production

- › Enzymes such as cleaning agents, paper production
- › Food supplements
- › Hormones (insulin), human serum albumin (HSA)

#### Chemical Production

- › Biofuels (ethanol, hydrogen, methane)
- › Biopolymer and sustainable chemicals
- › Novel synthesis routes for available chemicals

#### Microorganism Production

- › Microbial bioremediation agents
- › Brewing/baking supplies (yeast, microorganisms)
- › Brewing products (wine, beer, spirits)



# /// Importance of Bioreactors for Cell Culture and Fermentation

Bioreactors facilitate cell culture and fermentation processes, enabling various biological reactions. They allow researchers and manufacturers to employ different cultivation methods, including batch, fed-batch, and continuous culture.

## Cells

Mammalian (Human, Animal) & Insect cells

Grow in **suspension**



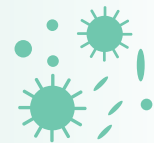
or **adherent** (require a surface to attach, e.g. microcarriers)



## Microorganisms

Bacteria, Fungi (mainly yeast),  
Algae (Plant) cells

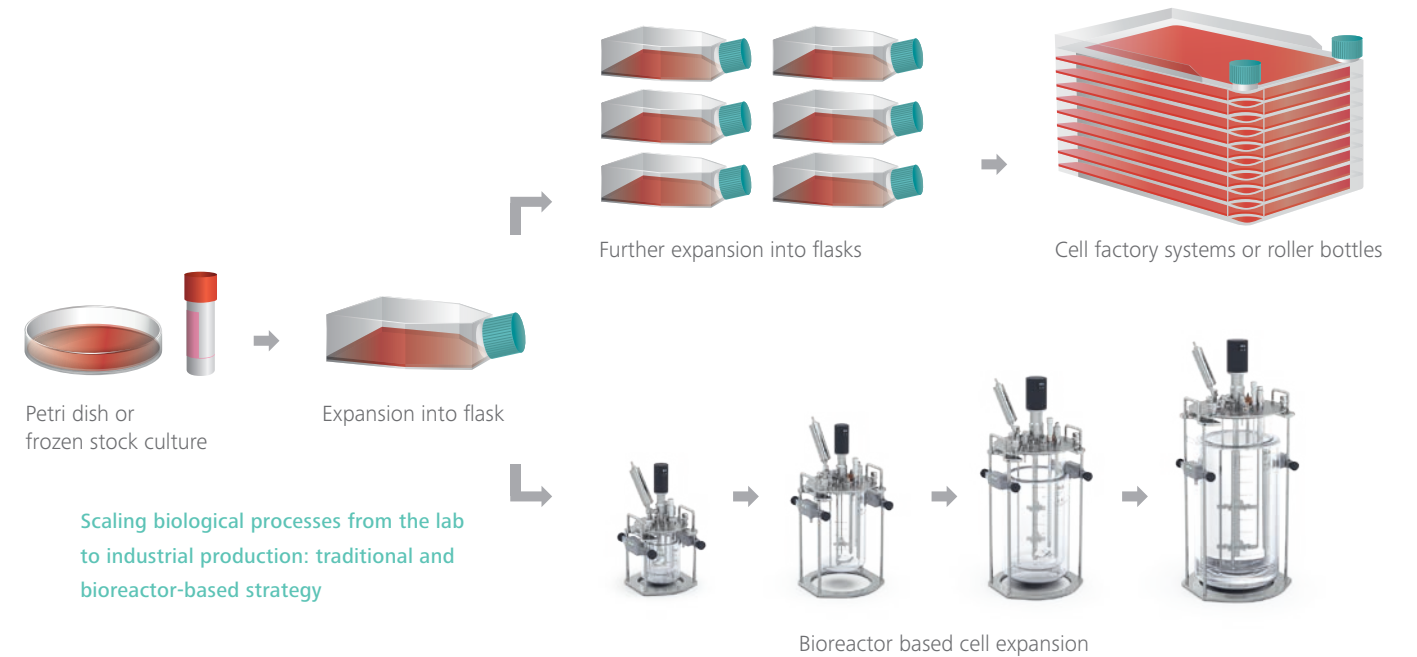
Always grow in **suspension**



Bioreactors are designed to provide a controlled and precisely regulated environments that emulate the natural living conditions necessary for cell growth and product formation. They are equipped with a variety of sensors that accurately measure and adjust key parameters such as pH, temperature, oxygen levels, and nutrient availability. By precisely controlling these environmental factors, bioreactors create an environment that meets the specific physiological and metabolic requirements of the cells or microorganisms being cultured. This customized environment promotes optimal growth conditions and enhances the production of desired biological products.



Scaling processes from the laboratory to industrial production presents numerous challenges. Bioreactors enable the transition of organisms from small-scale experimental setups to large-scale production units while maintaining their essential characteristics. This is achieved by exerting strict control over culture parameters throughout the scaling process. Maintaining precision during scale-up is crucial for consistent product quality, as it minimizes variations in the growth environment that could alter the organisms' behavior or the target product's composition. This level of precision is crucial for the consistent quality of the end product.



The data-driven nature of modern bioreactors provides a wealth of information that can be used to optimize growth parameters and process kinetics. Equipped with advanced sensors and data recording systems, these bioreactors can continuously monitor and record various environmental and biological variables, such as pH, temperature, dissolved oxygen, nutrient levels, and metabolite concentrations. By analyzing the data generated during the cultivation process, researchers and manufacturers can gain valuable insights that lead to improvements in scalability, efficiency, and yield. These data-driven optimizations enable the continual advancement of cellular and microbial production, making the bioreactor not just a vessel for growth, but a dynamic tool for process enhancement.





## /// Why IKA HABITAT Bioreactors are Optimal to Support Cell Culture and Fermentation?

### Precise environmental control for cell cultivation

Mass flow controllers precisely regulate the input of air, nitrogen, and oxygen, optimizing cell growth. Dissolved oxygen (DO) levels are a critical parameter in this process.

A dedicated carbon dioxide supply system maintains optimal pH levels, while headspace gassing options facilitate efficient oxygen transfer with minimal cellular perturbation. This precise control over the cell culture environment promotes consistent and reproducible experimental results.

### Advanced monitoring with next generation sensors

Advanced sensors for comprehensive bioprocess monitoring, including new-generation sensors for biomass, cell viability, and off-gas analysis, offer high selectivity, sensitivity, and long-term stability. These sensors enable contamination-free bioprocessing and improved operator efficiency by monitoring dissolved carbon dioxide, conductivity, turbidity, Redox, cell viability, off-gas, temperatures, and non-intrusive foam.

Soft-sensors can be used to calculate and display specific batch data, such as parameter setpoints, organism-specific rates ( $\mu$ ,  $q_s$ ,  $RQ$ , etc.), and extended batch values (culture broth weight, biomass).

### Reducing shear stress

IKA HABITAT Bioreactors have a reactor geometry with a pitched blade and impeller design that ensures a gentle yet efficient mixing without the risk of damage from excessive shear forces. This approach optimizes the growth and maintenance of suspension and sensitive adherent cells. A new chaotic mixing mode that follows mathematical principles of chaotic-dynamic systems also provides for a more homogeneous mixture.



## /// How IKA HABITAT Bioreactors Enhance Lab Operations?

IKA HABITAT Bioreactors are more than mere cultivation tools; they are integrated solutions designed to enhance operations with smoother, more efficient workflows tailored to the dynamic needs of our customers.

### Award-Winning Design

Recognized with the iF DESIGN AWARD 2023, the IKA HABITAT Bioreactor integrates the capabilities of a bioreactor, photobioreactor, and fermenter, reducing the need for multiple setups and switching. Its ergonomic handling, intuitive operation, and user-friendly features, such as an open skid, unique lid stand, and lightweight components, reduce operator fatigue and improve portability. The compact design maximizes bench space. The bioreactor's intelligent support systems and controls make it accessible to both beginners and experts.

### Consistent Quality

The IKA HABITAT Bioreactor sets the benchmark for consistent quality in bioprocessing by ensuring that each production cycle meets the high standards expected in the industry. Its sophisticated control systems and precision engineering provide a dependable foundation for operations, guaranteeing uniform outputs that streamline the entire downstream process. Variable-speed, bi-directional peristaltic pumps and an optional fifth pump provide for diverse fluid management. This fidelity in performance facilitates the scalability of production and significantly reduces the occurrence of batch failures, mitigating downtime and waste.

### Solutions that Scale

IKA HABITAT Bioreactors excel from micro-scale research to industrial production. They feature a chaotic mixing option for faster mixing, an advantage especially beneficial at the beginning of an experiment. The bioreactor's design includes a range of vessel volumes from 0.5L to 10L, available in both single and double-wall configurations. Properly-sized motors for each volume—small for up to 2L, and larger for 5L to 10L—ensure efficient operation and customization in contrast to the standard one-size-fits-all motor approach. Advanced, integrated control systems guarantee consistent scale-up processes, enabling seamless capacity growth.

### Cross-Platform Integration

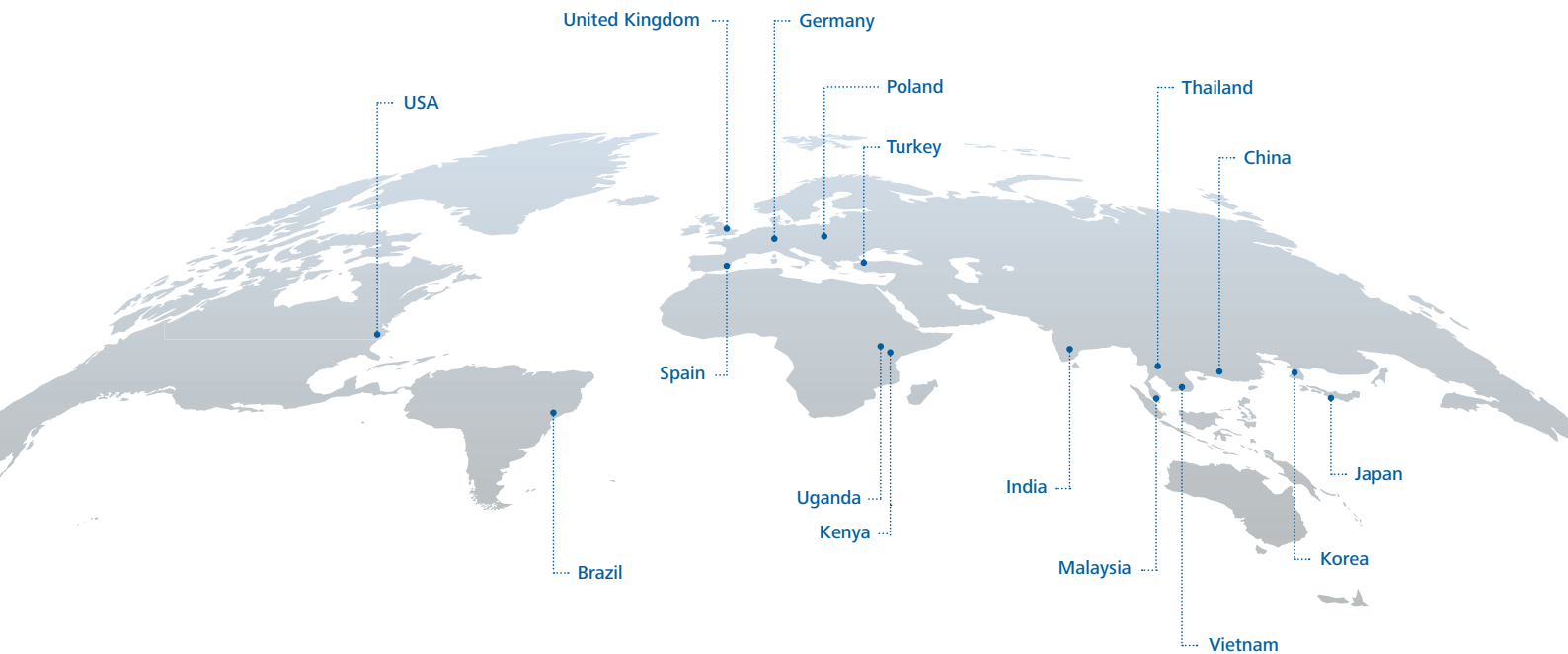
OPC UA integration and extensive interface options including USB, Ethernet, and RS-232 to provide comprehensive data connectivity. The lid's additional ports enable customized modifications to accommodate a range of bioprocessing applications.

### Worldwide Presence, Local Support

IKA's global presence provides comprehensive support, including technical service, spare parts, calibration, qualification, and commissioning, empowering customers to achieve their bioprocessing goals.



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