



## CHARACTERIZATION OF BIORACTOR SYSTEMS FOR THEIR OXYGEN TRANSFER RATE

Special focus on measurement of the mass transfer coefficient  $k_L a$

**Bioreactors are expected to provide optimum conditions for growth and product formation of microorganisms or the cell culture with the aim of maximising product formation.**

The oxygen transfer rate (OTR), and the  $k_L a$  value in particular, are the decisive parameters for the design of bioreactors. The volumetric mass transfer coefficient  $k_L a$  is used as the efficiency ratio of the transport of a gas from the gaseous phase to the liquid phase. In biotechnological processes, the  $k_L a$  coefficient indicates the efficiency of oxygen supply to microorganisms in a bioreactor. Possible measures to increase the  $k_L a$  value under gentle process conditions, which will in turn improve the overall performance of the organic process, include for example: increased agitator speed and gassing rate, optimization of fermenter and agitator geometry, enlarging the phase boundary (e.g. by aeration with finer gas bubbles) or optimization of the media composition. Since the  $k_L a$  value depends on numerous factors, it cannot be precisely calculated but needs to be determined by means of  $k_L a$  measurement at critical process points.



Highly flexible connection ports

## ZETA Services

### Characterization of fermenters

- Measurement on site at the customer premises
- Analysis of data and results
- Customer briefing
- Development of scale-down models

### Optimization of installed systems

- Process: Operational parameters
- Retrofitting: Agitator design – sparger design

### Designing and planning the optimum fermenter

- Pilot testing at the ZETA technical centre including scale-up calculations
- Specification and design of agitation systems in line with the process
- Customized solutions for individual processes

## Features of ZETA $k_{La}$ Measurement

- $k_{La}$  measurement in real time
- All process parameters are user definable
- Determination of the power input for the agitation system
- Adaptable for different gassing systems and sparger types
- Impeller power number determination
- Comparison of different cultivation broths
- Modular design for highest flexibility

## Benefits of ZETA $k_{La}$ Measurement

- Improved upstream process
- Optimized agitator geometry
- Improved product quality and safety
- Higher product yield
- Enabling QbD principles



- 1  $k_{La}$  test stand
- 2 Bubble free sampling
- 3 Multi port probe belt
- 4 Control tower
- 5 Control panel (aeration, agitator speed)

## ZETA $k_{La}$ measurement method

- Measurement of any point in the fermenter
- No structural changes of fermenter required
- Bubble separation prior to measurement for optimum measurement result
- Optical high-speed oxygen sensors with response times of <0.5 sec

