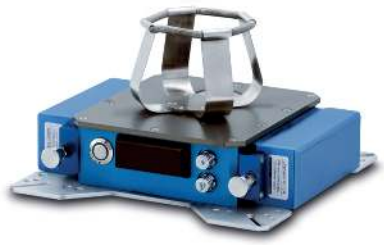
SYSTEMS

SFR vario



Shake Flask Reader for O2, pH, Biomass & OUR Measurement
Easy Integration in any Shaking Incubator

- Simultaneous real-time measurement of O_2, pH, and biomass
- Automatic OUR calculation
- Parallel measurements in up to 4 shake flasks
- Wireless data transfer enables easy integration
- Process development & media optimization

PreSens
PRECISION SENSING

Systems

SFR vario

The SFR vario offers online monitoring of oxygen, pH and biomass - simultaneously. The device optics can read out pre-calibrated oxygen and pH sensor spots - integrated in the ready-to-use cultivation vessels - and also comprise a dedicated optical set-up for biomass monitoring. The oxygen uptake rate (OUR) can be calculated from the slope of the online oxygen measurements. The system has two long-lasting, rechargeable batteries, and is compatible with any standard shaking incubators. Up to 4 SFR vario can be controlled from the SFR vario software. Measurement data is transferred wirelessly via Bluetooth to a PC / notebook.

Features

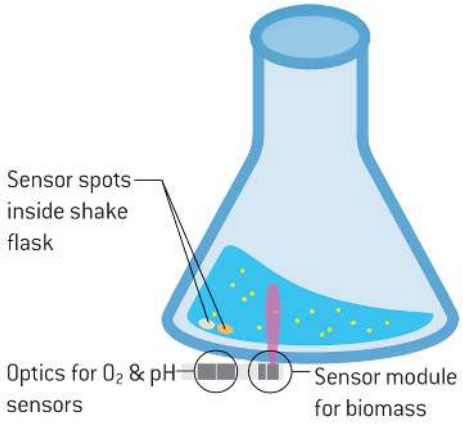
- Real-time measurement of O_2, pH, and biomass
- Automatic OUR calculation
- Used in media evaluation, bioprocess development & optimization
- Pre-calibrated cultivation vessels are ready-to-use
- Glass & plastic flasks in different sizes available
- O_2, OUR, pH & biomass functionality can be purchased separately to minimize your investment to your actual need

Software

The SFR vario is delivered with a basic software, which is the control center for the device. The connection between PC and the system inside the shaker is wireless. The software can control up to 4 SFR vario simultaneously. Oxygen, pH and biomass are visualized in real-time during the entire cultivation and former measurements can be compared with running measurements. The measurement data can be exported in different file formats (e.g. Microsoft Excel®) for further analysis.

Benefits

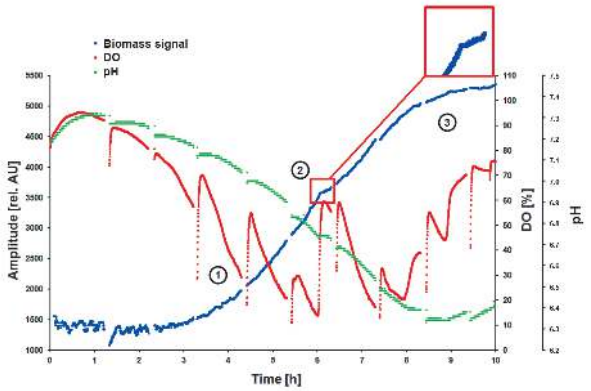
- Enables process monitoring in shake flasks
- Online optical biomass monitoring of microbial culture
- Systematic optimization of cultivation parameters



O2, pH, Biomass & OUR with One Device

PreSens´ proven technology for non-invasive measurement of oxygen and pH inside shake flasks is now extended to simultaneously monitor the biomass of your cultivation online. Oxygen and pH are measured with sensor spots integrated in the shake flasks, and the OUR of the culture can be calculated from the O_2 values. Optical biomass determination is based on turbidity measurement. The light emitted by an LED, hits the suspended particles inside the culture broth, is reflected, and the total reflection is detected by a photodiode. With the integrated acceleration sensor the device position during the shaking movement is determined; this enables adjusting the time of biomass measurement to the moment of maximum liquid above the optics.

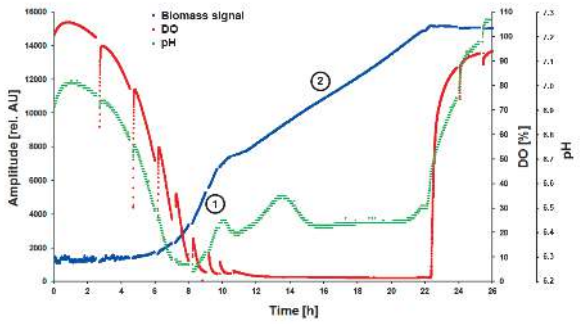
SFR vario



Examples for Applications

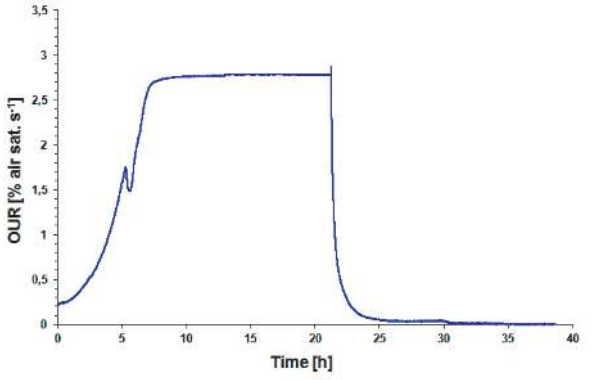
Biomass, 02 & pH monitoring during diauxic growth of E. coli

E. coli K12 shows distinct diauxic growth in medium containing glucose and lactose, which could be monitored with the SFR vario. Measurements were stopped several times for offline sampling - to determine substrate concentration - showing in gaps in the graphs. In the first growth phase glucose is consumed (1). The system reveals less precision in the lower biomass range, but this improves with increasing cell density. While the acetic acid produced by the bacteria lowers the pH of the medium the strong decrease of oxygen concentration down to 10 % a. s. indicates high metabolic activity. When the glucose concentration drops below 0.1 g L^{-1} after about 6 h (determined offline, data not shown here) growth stops and the oxygen level rises rapidly. This also shows in a small plateau (zoomed insert) in the online measured biomass curve (2). During this phase the bacteria adjust their metabolism to lactose. Recording this exact match in stop of oxygen consumption and growth could only be realized with the new online monitoring system. In the third phase *E. coli* grow on lactose until it is consumed and the culture turns into stationary phase (3).



Yeast growth phases in complex medium

K. marxianus shows two growth phases when cultured in shake flasks with glucose as substrate. In the first phase glucose is metabolized under aerob conditions (1), and the oxygen content decreases continuously down below 5 % a. s. . Due to metabolic products the pH decreases from a value of 7 to 6.1. After 9 hours cultivation period the glucose is completely consumed (determined offline, data not shown here), and pH increases again. During the second - oxygen limited - phase *K. marxianus* shows significantly slower growth, which can be clearly observed in the scattered light (= biomass) measurements (2), while metabolizing the glucose products generated in the first phase under high oxygen demand. The simultaneous monitoring of oxygen, pH and biomass with the SFR vario offers whole new possibilities for culture monitoring and evaluation of metabolic processes.



Oxygen Uptake Rate Measurements

Measuring the oxygen uptake rate of microorganisms is a very good indicator for metabolic activity and can be used to predict the state of growth or evaluate the rate at which metabolic processes take place. The graph on the left shows the OUR of *S. cerevisiae* in YPD medium during shake flask cultivation. The oxygen uptake rate rises constantly during the first hours of cultivation due to exponential growth. A short drop in oxygen uptake rate indicates that substrate became limiting, and the microorganisms reduce metabolic activity while switching to metabolise another substrate. Then another phase of exponential growth sets in. The period of maximum metabolic activity with highest OUR, as well as the time point when death phase sets in (due to oxygen limitation) and OUR abruptly drops to minimum values, can be clearly determined from the graph.

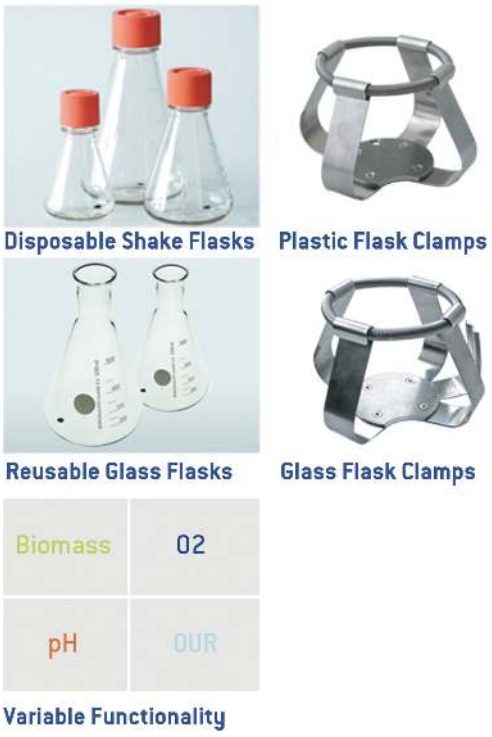
SFR vario

Specifications	Oxygen	pH*	Biomass
Measuring range	0 - 100 % O_2	5.5 - 8.0 pH	Optical Density OD_{600} 1 - 80
Response time (t_{90}) at 25 °C	< 60 s	< 60 s	-
Resolution	± 0.01 % O_2 at 0.21 % O_2 ± 0.1 % O_2 at 20.9 % O_2	± 0.01 pH at pH = 7**	Depending on culture
Accuracy	± 0.4 % O_2 at 20.9 % O_2 ± 0.05 % O_2 at 0.2 % O_2	± 0.1 pH at pH = 7 with one-point adjustment ± 0.2 pH at pH = 7 with pre-calibration	Depending on culture
Drift	< 0.01 % O_2 per day (sampling interval of 1 min.)	< 0.01 pH per day (sampling interval of 1 min.)	Depending on culture
Properties			
Temperature range	from 5 °C to 50 °C		
Compatibility	aqueous solutions, ethanol (max. 10 % v/v), methanol (max. 10 % v/v), pH 2 - 10		
Cross-sensitivity	typically no cross-sensitivity in culture media	reduced to ionic strength (salinity); a high concentration of small fluorescent molecules in the visible range can interfere	
Sensor flasks are delivered irradiated.			

*provided Sensor Flasks are used without further handling in physiological solutions
** at 100 rpm & cell culture media

SET-UP

ACCESSORIES



Technical data can change without prior notice.

Bring to light what's inside. Ask our experts:

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