

Measuring k_La values on the CellMaker PLUS
to show better performance and improved oxygen supply control.

QUALITY | RELIABILITY | SERVICE EXCELLENCE | PRODUCTIVITY

Introduction

Measurements of k_La values, namely the volumetric mass-transfer coefficient describing efficiency with which oxygen can be delivered for a given set of conditions, provides important information about cell culture bioprocesses. It also provides an efficiency measure of the bioreactor system used.

The dissolved oxygen (DO) level is often the limiting substrate in fermentation and cell culture processes. For bacteria and yeast cultures in particular there is a critical oxygen concentration above which it no longer limits growth. It is therefore important to be able to maintain DO levels above this critical level by sparging the bioreactor system with air or pure oxygen. In addition the mass transfer rate of oxygen should be equal to, or exceed, the rate to which the growing cells take up the oxygen.

Determination of k_La values therefore provides information that enable one to ensure that an adequate supply of oxygen is available for the most efficient proliferation of the cell culture. The k_La value can also be used to optimize control variables over the life cycle of the cell culture process, with this optimization based on the oxygen demand at different points in the process and growth phases.

The oxygen transfer rate is strongly influenced by the hydrodynamic conditions in the bioreactor which are a function of energy dissipation that depends on operational conditions, physicochemical properties of the culture, geometrical parameters of the bioreactor and also on the presence of oxygen consuming cells. The correct measurement and/or prediction of k_La is a crucial step in design, operation and scale-up of bioreactors and is key to controlling oxygenation at the optimal rate.

This application notes describes measurement of k_La values on the CellMaker PLUS system, a unique single-use bioreactor designed with a novel air dispersion technology to improve aeration of the cell culture and includes full pH, DO and temperature control to provide automated optimization of the culture conditions.

Experimental conditions

A series of experiments were performed in the CellMaker PLUS single use bioreactor systems to determine the k_La values for differing levels of gas input.

The instrument that was used was a CellMaker PLUS 8L single use bioreactor system from Cellexus which is provided with built-in pH and DO probes. Experiments were set up with the following parameters:

Medium	5 litres de-ionised water
Head	220mm
Temperature	36°C
Purge Gas	Nitrogen

Three separate experiments were run with gas flows of 7 litres per minute (LPM), 3 LPM and 1.75 LPM.

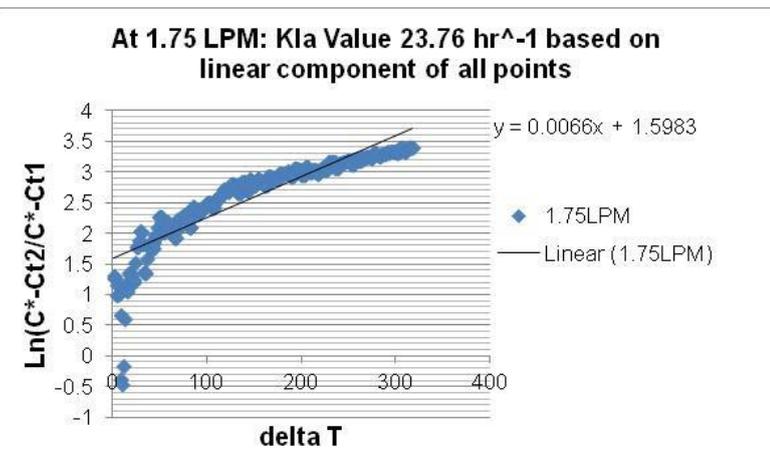
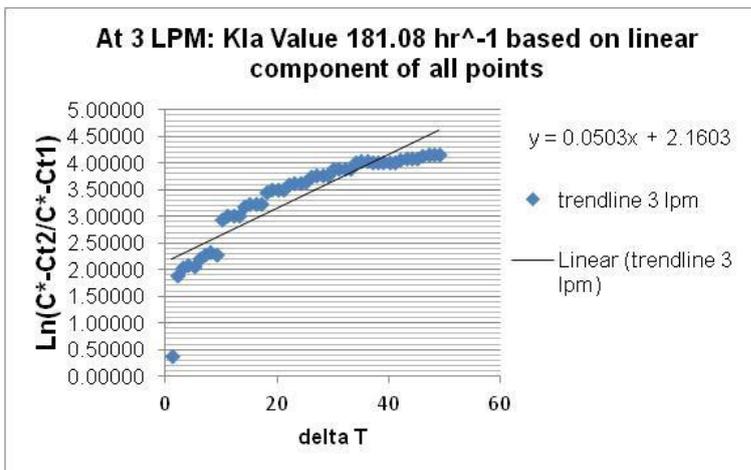
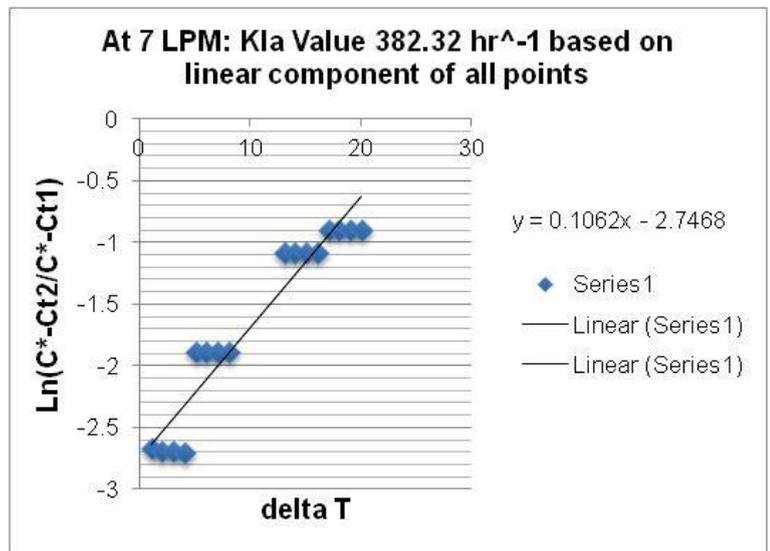
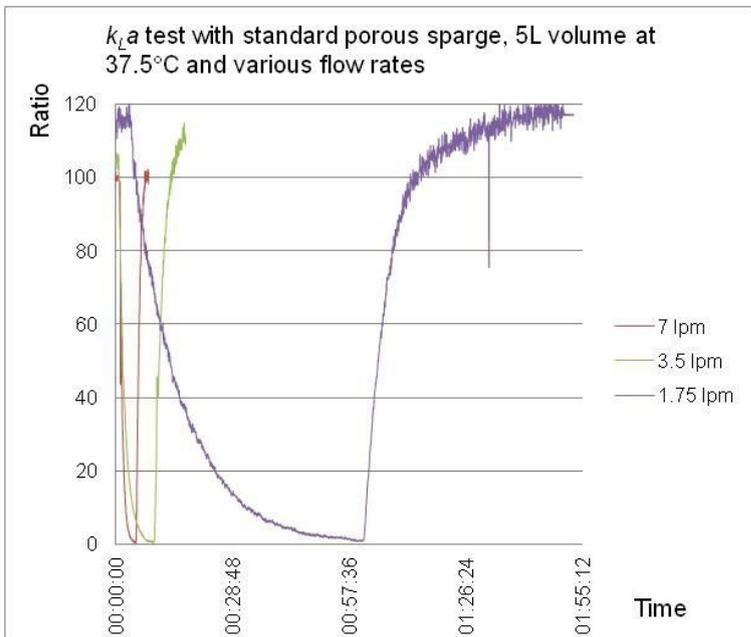
Application Note:

Measuring k_La values on the CellMaker PLUS to show better performance and improved oxygen supply control.



Results

The results were as follows:



Application Note:



Measuring k_La values on the CellMaker PLUS to show better performance and improved oxygen supply control.

QUALITY | RELIABILITY | SERVICE EXCELLENCE | PRODUCTIVITY



k_La values

Flow rate	7 LPM	3.5 LPM	1.75 LPM
k_La value	382.32 h ⁻¹	181.08 h ⁻¹	23.76 h ⁻¹

Conclusions

These experiments show there is variation in k_La at different gas flow rates and therefore the importance of being able to effectively control DO levels to ensure the critical, optimal DO levels are maintained for most efficient cell growth. This is particularly crucial with bacterial and yeast cultures where the critical oxygen level is usually 10 – 50% air saturation.

Measuring k_La thus provides:

- Assurance that cell culture growth is not impeded by inadequate DO levels
- Ability to fine-tune DO for optional cell culture growth
- Facility to prevent wasted energy and cost associated with un-necessarily high DO levels

The in-built DO sensors in the single use cell culture bags which used on the CellMaker PLUS system from Cellexus, together with the flexible controller software provided with the instrument, allows for automated adjustment of air flow sparge rates and / or the use of oxygen to enrich incoming gasses to maintain the most appropriate DO levels.

CellMaker Controller

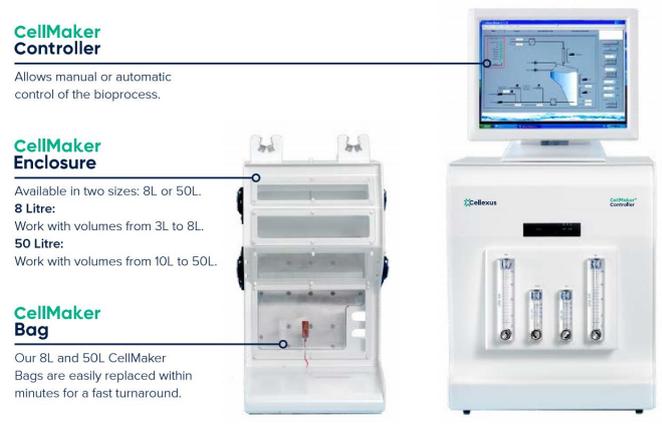
Allows manual or automatic control of the bioprocess.

CellMaker Enclosure

Available in two sizes: 8L or 50L.
8 Litre:
Work with volumes from 3L to 8L.
50 Litre:
Work with volumes from 10L to 50L.

CellMaker Bag

Our 8L and 50L CellMaker Bags are easily replaced within minutes for a fast turnaround.



CellMaker single use bioreactor system

For further details, or to request a quotation, contact us now.

Contact details

Headquarters - United Kingdom
Cellexus International Limited
6 Riverside Court, Mayo Avenue
Dundee
DD2 1XD
UK

Email: sales@cellexus.com
Office: +44 (0)1382 666357



For full details of our distributors please see our website.

www.cellexus.com