

# Determination of $k_L a$ Values of Single-Use Bioreactors

DECHEMA® Gesellschaft für Chemische Technik und Biotechnologie e.V. (Society for Chemical Engineering and Biotechnology) brings together experts from a wide range of disciplines, institutions, and generations to stimulate scientific exchange in chemical engineering, process engineering, and biotechnology [1].

Single-use bioreactors are increasingly used in research, process development, and production. Like conventional reusable systems they have to allow the setup of optimal growth conditions. A sufficient supply of oxygen is crucial for aerobic bioprocesses, and the velocity of oxygen entry into the culture medium is often described by the volumetric mass transfer coefficient ( $k_L a$ ). Because single-use bioreactors offered by different manufacturers vary in parameters critical for oxygen transfer—like mixing, power input, and gassing strategies—they are often not directly comparable to each other and to conventional glass and stainless steel vessels. Even  $k_L a$  values experimentally determined by the manufacturer or users are not necessarily comparable, because the results might differ dependent on the method used.

## DECHEMA published guideline for $k_L a$ -determination

To help the users to objectively compare the performance of bioreactors in terms of oxygen transfer, the DECHEMA expert group on “Single-Use technology in biopharmaceutical manufacturing” developed a standard operating procedure (SOP) for  $k_L a$  measurements. Using this protocol, different manufacturers experimentally determined the  $k_L a$  values of single-use bioreactors they offer. A DECHEMA report summarizes the results [2], (Figure 1). It also describes in detail the SOP used, to offer scientists a guideline to determine the  $k_L a$  values for any bioreactor of interest.

## $k_L a$ values of Eppendorf BioBLU® Single-Use Vessels

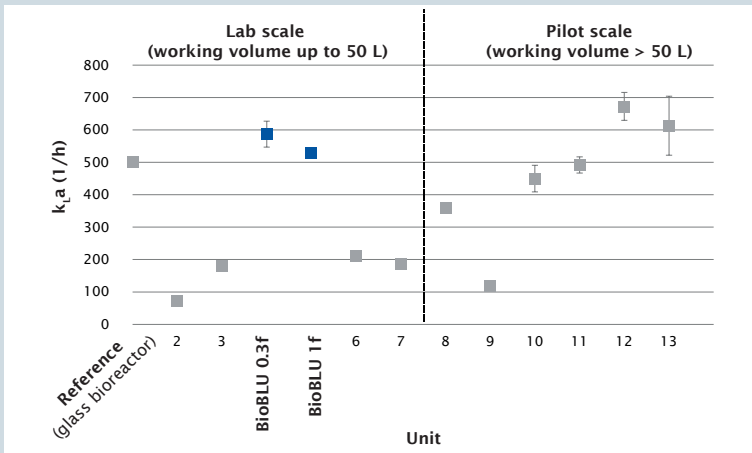
Eppendorf determined the  $k_L a$  values of two single-use vessels for microbial applications, namely the Eppendorf BioBLU® 0.3f Single-Use Vessel with a maximum working volume of 250 mL and the Eppendorf BioBLU 1f Single-Use Vessel with a maximum working volume of 1.25 L (Figure 2). For both vessels the Eppendorf application lab measured  $k_L a$  values  $> 500 \text{ h}^{-1}$ , which is considerably higher than the values of the other lab-scale fermentors tested (Figure 3).



Fig. 1: The DECHEMA report “Recommendations for process engineering characterization of single-use bioreactors and mixing systems by using experimental methods” contains the SOP used for  $k_L a$  determination, results, and background information.



Fig. 2: Eppendorf BioBLU 0.3f (left) and 1f (right) Single-Use Vessels.



**Fig. 3:** Volumetric mass transfer coefficients of single-use bioreactors of different manufacturers (numbered), the Eppendorf BioBLU 0.3f and 1f Single-Use Vessels, and a glass stirred-tank fermentor as reference.  $k_L a$ -values were determined using the SOP described in [2].

### Outlook

In their report, the DECHEMA group also published guidelines for the experimental determination of specific power input for bioreactors and the mixing time, and they plan to develop further SOPs, such as one for the

determination of the volumetric mass coefficient for CO<sub>2</sub>. These protocols will be valuable guidelines to standardize experiments for the characterization of bioreactor performance and to facilitate their comparison.

### References

- [1] <http://dechema.de/en/About+DECHEMA.html>
- [2] DECHEMA Expert Group Single-Use Technology; Recommendations for process engineering characterization of single-use bioreactors and mixing systems by using experimental methods; 2016 <http://dechema.de/studien.html>

### Ordering information

Vessel	Impellers	Quantity	Order number
BioBLU® 0.3f	2 x Rushton-type	4-pack	78903509
BioBLU® 1f	2 x Rushton-type	4-pack	78903513
	3 x Rushton-type	4-pack	78903505
BioBLU® 3f	3 x Rushton-type	1-pack	1386000900
	3 x Rushton-type	4-pack	1386001000

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 Eppendorf AG · 22331 Hamburg · Germany  
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