NAGASE

OTR Simulator

- Rigorous Calculation of Fermenter OTR -

NAGASE & CO. developed a simulator performing rigorous calculation of Oxygen Transfer Rate (OTR), which is an important factor of aerobic cultures scale-up.

Background

In many cases of aerobic cultures, oxygen transfer rate (OTR) well correlates the productivity of objective fermentation compound. Thus OTR is regarded as a critical factor for fermentation scale-up, and OTR estimations under given conditions have been performed for a long time. However, in the conventional method, some parameters (dissolved oxygen concentration and saturated-dissolved oxygen concentration) are fixed as assumed values, and this may cause inaccuracy of the estimation. Here, we developed a simulator executing rigorous calculation of fermenter OTR.

Method

Decrease of partial pressure of oxygen in gas phase caused by respiration of cultured cells and following lowering of saturated-dissolved oxygen concentration in liquid phase are calculated. Oxygen uptake rate (OUR) of the cultured cells is expressed by a function of dissolved oxygen concentration. Under the assumption of a steady state, which means OTR is equal to OUR, an oxygen concentration value that satisfies the given conditions can be found. Thus, theoretical, not a priori, values of saturated-dissolved oxygen concentration and oxygen concentration are estimated. The desired OTR is calculated by using these values and a given k_La. A simulator implementing these procedures is developed by EQUATRAN-G (Omega simulation) and Excel (Microsoft).

Estimation examples

Figure 1 shows the examples of estimation. By the conventional method, aeration rate has no effect for calculated OTR. However, our simulator estimates the lowering of OTR accompanying with decrease of aeration rate, even if k_La is set to a same value. This result suggests that one should pay attention to aeration rate, not only to k_La, when studying scale-up focused on OTR. Thus the OTR simulator is especially valuable for estimating OTR of micro-aerobic cultures with extremely low aeration rate or cultures involving large consumption of oxygen caused by respiration of very high concentration cells.

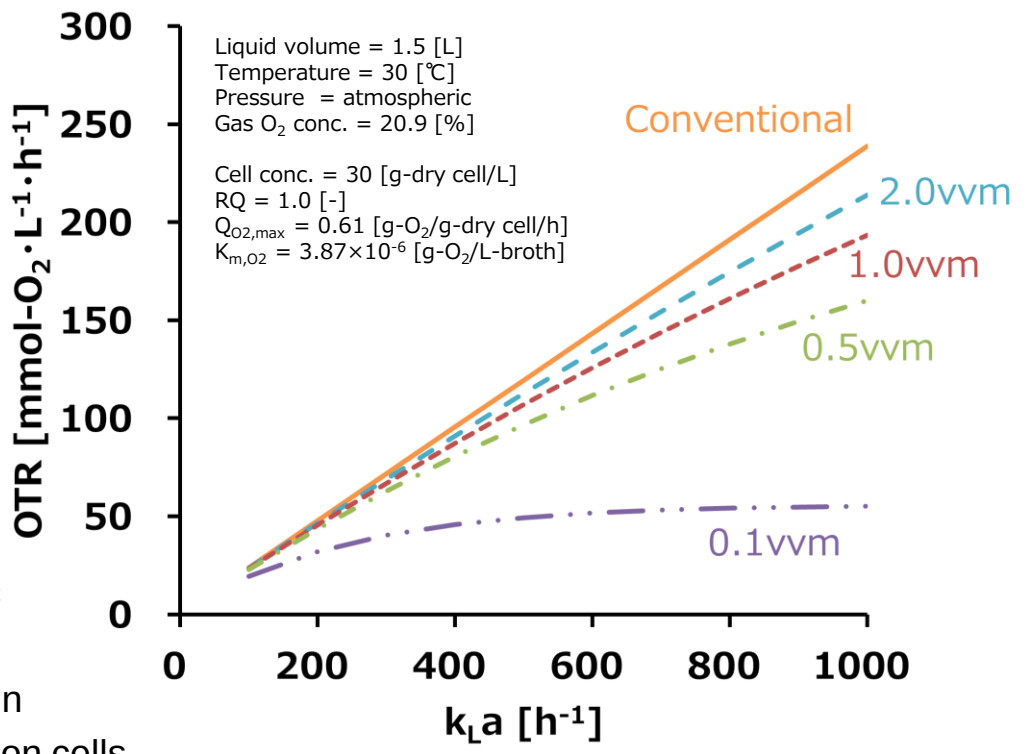

Figure 1. Examples of OTR simulation

The NAGASE BIO-INNOVATION CENTER is committed to developing processes for efficiently producing a wide range of compounds with proprietary fermentation technologies.

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