

Correlation for the maximum oxygen transfer capacity in shake flasks for a wide range of operating conditions and for different culture media.

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Abstract

Characterization of shake flasks is essential to ensure a sufficient oxygen supply for aerobic microorganism. To determine the volumetric mass transfer coefficient $k_L a$ or the maximum oxygen transfer capacity $OTR_{\max}$ the [sulfite](#) system is commonly applied. It has been used for non-baffled shake flasks based on the assumption of a proportionality between the $k_L a$ of the sulfite system and of a biological culture. This work proves this to be valid only for shaking frequencies above 300 rpm. Below the proportionality factor depends on the shaking frequency. More than 350 experiments with different concentrations of the sulfite system, 16 different media compositions and 10 different microorganisms were evaluated varying the shaking diameter (1.25–10 cm), flask diameter (51–131 mm), filling volume (2–160 mL) and shaking frequency (100–450 rpm). For the first time the properties of the culture media are coherently represented by a term based on the easily accessible osmolality. An universal consistent equation to calculate the $OTR_{\max}$ for non-baffled shake flasks for an exhaustive range of shaking conditions was developed and validated by experimental data. The deviations are within a remarkable narrow range of $\pm 5 \text{ mmol L}^{-1} \text{ h}^{-1}$.

Involved units

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