Application Note

K_La / Oxygen Transfer Rate in microbial fermentation

The OUR (Oxygen Uptake Rate) of a specific organism defines the required OTR.

OTR = K_La x delta C

E. Coli at normal cell density has an OUR = 100 – 150 mmol/l.hr. Pichia requires a higher OUR, maybe 200 mmol/l.hr.
When measuring Dissolved Oxygen: DO = 0% means OUR = OTR(max)

For AIR (at 25°C): delta C9Max) = 0.25mmol/L.
For Oxygen the delta C(max) = 1.25 mmol/L, but this will never be reached because 100% Oxygen cannot be reached due to the presence of CO_2 and therefore 1 mmol/L is chosen in the calculations.

⇒ an OUR = 200mmol/Lh^{-1} requires with AIR K_La (min): 200/0.25 = 800h^{-1}
with O_2 K_La (min): 200/1 = 200h^{-1}

The CELL-tainer should be able to reach K_La > 500h^{-1} at max rpm and 10L liquid volume. (july 2009: not yet verified)

OTR (max) with AIR: 500 x 0,25 = 125 mmol/L.h^{-1}
OTR (max) with Oxygen: 500 x 1 = 500 mmol/L.h^{-1}

The CELL-tainer does meet the needs of most microbial processes. Known is that some large biotech industries in the traditional fermentation take as target for their microbial fermentation an OTR > 125 mmol/Lh^{-1} with AIR.

In most microbial fermentation media the K_La higher than in water (non-coalescent), but at 30-35°C the solubility of oxygen in water decreases. A kind of compensation of effects is the result.