

Parameter	Value	Unit
$r$	$1.32 \times 10^{-6}$	m
$\varepsilon_m$	$1.55 \times 10^{-5}$	dimensionless
$Y_{photo}^{Chl:Fe}$	$1.91 \times 10^2$	mol C mol Fe <sup>-1</sup>
$\lambda^{max}$	$2.51 \times 10^{-18}$	mol C cell <sup>-1</sup> s <sup>-1</sup>
$C_S$	0.00	mol C cell <sup>-1</sup>
(initial value)		
$N_S$	$2.21 \times 10^{-15}$	mol N cell <sup>-1</sup>
(initial value)		
$K_{N_S}$	$8.83 \times 10^{-16}$	mol N cell <sup>-1</sup>
$C_B$	$1.45 \times 10^{-13}$	mol C cell <sup>-1</sup>
$N_B$	$2.41 \times 10^{-14}$	mol N cell <sup>-1</sup>
$C_S^{max}$	$1.19 \times 10^{-13}$	mol C cell <sup>-1</sup>
$R_{C_S}$	$6.32 \times 10^{-5}$	s <sup>-1</sup>
$p_I^{max}$	$7.28 \times 10^{-3}$	s <sup>-1</sup>
$A_I$	$3.00 \times 10^{-3}$	μmol <sup>-1</sup> m <sup>2</sup> s
$B_I$	$6.46 \times 10^{-1}$	dimensionless
$C_I$	$6.90 \times 10^{-3}$	μmol <sup>-1</sup> m <sup>2</sup> s
$D_I$	$7.76 \times 10^0$	dimensionless
$A_T$	$8.00 \times 10^3$	Dimensionless

$D_{Cs}^{max}$	$5.21 \times 10^{-18}$	mol C cell <sup>-1</sup> s <sup>-1</sup>
$K_{Cs}^{Dec}$	$6.30 \times 10^{-15}$	mol C cell <sup>-1</sup>
$PI$	$2.00 \times 10^0$	dimensionless
$C_{O_2}^{potential}$	$2.00 \times 10^{-26}$	unit depends on $PI$
$C_{Fe}^{N_2fix}$	$1.00 \times 10^{-1}$	mol N mol Fe <sup>-1</sup> s <sup>-1</sup>
$[O_2^{cell}]_{cri}$	$1.00 \times 10^{-1}$	mol O <sub>2</sub> m <sup>-3</sup>
$C_B^P$	$2.40 \times 10^{-1}$	s <sup>-1</sup>
$K_{Fe}$	$4.53 \times 10^{-19}$	mol Fe cell <sup>-1</sup>
$Fe_P^{min}$	$2.54 \times 10^{-18}$	mol Fe cell <sup>-1</sup>
$R_P^B$	$5.00 \times 10^{-4}$	s <sup>-1</sup>
$R_N^B$	$3.33 \times 10^{-3}$	s <sup>-1</sup>
$C_B^N$	$2.39 \times 10^{-15}$	unit depends on $P2$
$P2$	$3.00 \times 10^0$	dimensionless
$[O_2^{cell}]_{cri}^{nitroge}$	$3.26 \times 10^{-1}$	mol O <sub>2</sub> m <sup>-3</sup>
$K_{Cs}^{nitroge}$	$3.15 \times 10^{-14}$	mol C cell <sup>-1</sup>
$N_S^{max}$	$4.59 \times 10^{-13}$	mol N cell <sup>-1</sup>
$N_{2fix}^{max}$	$5.21 \times 10^{-19}$	mol N cell <sup>-1</sup> s <sup>-1</sup>

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The parameters are for 20% O<sub>2</sub> environment. For 5% O<sub>2</sub> environment, we have used  $r = 1.28 \times 10^{-6}$  (m) and other per-cell values except for  $N_{2fix}^{max}$  are proportionally adjusted based on the volume ( $V = 4/3\pi r^3$ ) difference between the two O<sub>2</sub> cases.  $\epsilon_m$  is a diffusivity of cellular membrane relative to water, which influences  $\kappa_{O_2}$  (1).

## Reference

1. **Inomura K, Bragg J, Follows MJ.** 2017. A quantitative analysis of the direct and indirect costs of nitrogen fixation: a model based on *Azotobacter vinelandii*. *ISME J* **11**:166–175.