

TABLE 1. Monod expressions and kinetics constants reported for suspended *A. ferrooxidans* cultures

Reference	Kinetics model	Kinetics constants ^a	Expt. conditions	Comput. method	Expt. system	Monitored parameter	Comments
19	$\mu = \frac{\mu_{\max}[\text{Fe}^{2+}]}{K_S \left(1 + \frac{[\text{Fe}^{2+}]}{K_P}\right) + [\text{Fe}^{2+}]}$	μ_{\max} , 1.25 h ⁻¹ ; K_S , 0.048 g liter ⁻¹ ; K_P , 0.06–0.11 g liter ⁻¹	pH 1.6, 30°C	Linweaver-Burk	Chemostat	[Fe(II)]	Competitive inhibition by Fe ³⁺
19	$\mu = \frac{\mu_{\max}[\text{Fe}^{2+}]}{\left(1 + \frac{[\text{Fe}^{2+}]}{K_P}\right)(K_S + [\text{Fe}^{2+}])}$	μ_{\max} , 1.78, 1.33 h ⁻¹ ; K_S , 0.04, 0.13 g liter ⁻¹ ; K_P , 0.06, 0.15 g liter ⁻¹	pH 1.6, 30°C	Linweaver-Burk	Chemostat	[Fe(II)]	Noncompetitive inhibition by Fe ³⁺
23	$\mu = \frac{\mu_{\max}[\text{Fe}^{2+}]}{K_S \left(1 + \frac{[\text{Fe}^{2+}]}{K_P}\right) + [\text{Fe}^{2+}]}$	μ_{\max} , 0.11 h ⁻¹ ; K_S , 0.05 g liter ⁻¹ ; K_P , 0.44 g liter ⁻¹	pH ₀ 1.8, 35°C	Linweaver-Burk	Batch	[Fe(II)]	Competitive inhibition by Fe ³⁺ , no pH control
23	$\mu = \frac{\mu_{\max}[\text{Fe}^{2+}]}{K_S \left(1 + \frac{[\text{Fe}^{2+}]}{K_P}\right) + [\text{Fe}^{2+}]}$	μ_{\max} , 0.12 h ⁻¹ ; K_S , 0.09 g liter ⁻¹ ; K_P , 2.32 g liter ⁻¹	pH 1.8, 35°C	Linweaver-Burk	Chemostat	[Fe(II)]	Competitive inhibition by Fe ³⁺
47	$\frac{d[\text{O}_2]}{dt} = \frac{q_{\max}[\text{Fe}^{2+}]X}{K_S \left(1 + \frac{X}{K_i}\right) + [\text{Fe}^{2+}]}$	q_{\max} (nmol O ₂ min ⁻¹ mg cell ⁻¹), (a) 88 and 143, (b) 125 and 100; K_S (g liter ⁻¹) (a) 0.02 and 0.04, (b) 0.01 and 0.02; K_i (mg cell · ml ⁻¹), (a) not determined, (b) 0.33 and 0.11	pH 2.3, 25°C	Linweaver-Burk	Initial rates	Oxygen consumption rate	Competitive inhibition by <i>A. ferrooxidans</i> cells
24	$\frac{d[\text{O}_2]}{dt} = \frac{q_{\max}[\text{Fe}^{2+}]X}{K_S \left(1 + \frac{X}{K_i} + \frac{[\text{Fe}^{2+}]}{K_P} + \frac{X[\text{Fe}^{2+}]}{\alpha K_S K_P}\right) + [\text{Fe}^{2+}]}$	q_{\max} , 200 nmol O ₂ min ⁻¹ mg cell ⁻¹ ; K_S , 0.004 g liter ⁻¹ ; K_i , 0.135 (mg cell) ml ⁻¹ ; K_P , 0.036 g liter ⁻¹ ; α , 5.0	pH 2.3, 25°C	Linweaver-Burk	Initial rates	Oxygen consumption rate	Synergistic competitive inhibition by <i>A. ferrooxidans</i> cells and Fe ³⁺
32	$\mu = \frac{\mu_{\max}[\text{Fe}^{2+}]}{K_S \left(1 + \frac{[\text{Fe}^{2+}]}{K_P}\right) + [\text{Fe}^{2+}] + \frac{[\text{Fe}^{2+}]^2}{K_d}}$	μ_{\max} , 0.23 h ⁻¹ ; K_S , 0.94; K_P , 12.0 g liter ⁻¹	pH 1.8, 18–37°C	Nonlinear regression	Chemostat	[Fe(II)]	Competitive inhibition by Fe ³⁺ ; Fe ²⁺ inhibition
34	$\frac{d[\text{Fe}^{2+}]}{dt} = \frac{V_{\max}[\text{Fe}^{2+}]X}{K_S \left(1 + \frac{[\text{Fe}^{2+}]}{K_P}\right) + [\text{Fe}^{2+}]}$	K_S (g liter ⁻¹), (a) 0.037, (b) 0.028; K_P (g liter ⁻¹) (a) 0.35, (b) 0.4	pH 2.0, 27°C	Linear regression	Initial rates	[Fe(II)]	Competitive inhibition by Fe ³⁺ ; strains of <i>A. ferrooxidans</i> used were ATCC 13598 (a) and ATCC 13661 (b)
12	$\mu = \frac{\mu_{\max}[\text{Fe}^{2+}]}{K_S \left(1 + \frac{[\text{Fe}^{2+}]}{K_P}\right) + [\text{Fe}^{2+}]}$	μ_{\max} , 0.14 h ⁻¹ ; K_S , 0.94 g liter ⁻¹ ; K_P , 0.315 g liter ⁻¹	pH ₀ 2.0, 30°C	Nonlinear regression	Batch	Biomass concn	Competitive inhibition by Fe ³⁺ ; no pH control; [Fe ²⁺] at end around 0.5 g liter ⁻¹
29	$\frac{d[\text{Fe}^{2+}]}{dt} = \frac{K_{\text{eff}} e^{-\beta RT} X [\text{Fe}^{2+}]}{K_S \left(1 + \frac{X}{K_i}\right) + [\text{Fe}^{2+}] + \left(1 - \frac{X}{\beta}\right) \frac{[\text{Fe}^{2+}]^2}{\alpha}}$	K_{eff} , 6,438 g liter ⁻¹ h ⁻¹ (cells ml ⁻¹); K_S , 0.0672 g liter ⁻¹ ; K_P , 2.68 × 10 ⁷ cells ml ⁻¹ ; E , 68.4 kJ mol ⁻¹ ; α , 26.1 g liter ⁻¹ ; β , 7.8 × 10 ⁸ cells ml ⁻¹	pH 2.0, 20–35°C	Nonlinear regression	Initial rates	Redox	Competitive inhibition by <i>A. ferrooxidans</i> cells; Fe ²⁺ inhibition
15	$\mu = \frac{\mu_{\max}[\text{Fe}^{2+}]}{K_S \left(1 + \frac{[\text{Fe}^{2+}]}{K_P}\right) + [\text{Fe}^{2+}] + \frac{[\text{As}^{3+}]}{K_A}}$	μ_{\max} , 0.16 h ⁻¹ ; K_S , 0.073 g liter ⁻¹ ; K_P , 0.78 g liter ⁻¹ ; K_A , 21.75 g liter ⁻¹	pH 1.8, 35°C	Nonlinear regression	Redox controlled reactor	Redox	Competitive inhibition by Fe ³⁺ , As ³⁺ inhibition
31	$\frac{d[\text{Fe}^{2+}]}{dt} = \frac{K_{\text{eff}} e^{-\beta RT} X [\text{Fe}^{2+}]}{\left(1 + \frac{[\text{Fe}^{2+}]}{K_P}\right)(K_S + [\text{Fe}^{2+}])}$	K_{eff} , 3,077 g liter ⁻¹ h ⁻¹ (cells ml ⁻¹); K_S , 0.258 g liter ⁻¹ ; K_P , 2.06 g liter ⁻¹ ; E , 68.4 kJ mol ⁻¹	pH 2.0, 35°C	linear regression	Initial rates	Redox	Noncompetitive inhibition by Fe ³⁺
4	$\mu = \frac{\mu_{\max} + m_0 \cdot Y_{\text{max}}^{\text{O}_2}}{1 + \frac{K_S}{[\text{Fe}^{2+}] - [\text{Fe}^{2+}]_L} + \frac{K_S}{K_P} \frac{[\text{Fe}^{3+}]}{[\text{Fe}^{2+}] - [\text{Fe}^{2+}]_L} - m_0 \cdot Y_{\text{max}}^{\text{O}_2}}$	K_S/K_P , 0.08; μ_{\max} , 0.096 h ⁻¹ ; $Y_{\text{max}}^{\text{O}_2}$, 0.052 C-mol (mol O ₂) ⁻¹ ; m_0 , 0.24 mol O ₂ (C-mol h) ⁻¹	pH 1.8, 30°C	Nonlinear regression	Batch	Off-gas analysis of O ₂	Competitive inhibition by Fe ³⁺ , including cells' maintenance requirements; pH controlled
4	$\mu = \frac{\mu_{\max} + (m_0 \cdot Y_{\text{max}}^{\text{O}_2})}{1 + \frac{K_S}{[\text{Fe}^{2+}] - [\text{Fe}^{2+}]_L} + \frac{K_S}{K_P} \frac{[\text{Fe}^{3+}]}{[\text{Fe}^{2+}] - [\text{Fe}^{2+}]_L} - m_0 \cdot Y_{\text{max}}^{\text{O}_2}}$	K_S/K_P , 0.04; μ_{\max} , 0.096 h ⁻¹ ; $Y_{\text{max}}^{\text{O}_2}$, 0.051 C-mol (mol O ₂) ⁻¹ ; m_0 , 0.1 mol O ₂ (C-mol h) ⁻¹	pH 1.8, 30°C	Nonlinear regression	Chemostat	Off-gas analysis of O ₂	Competitive inhibition by Fe ³⁺ , including cells' maintenance requirements; pH controlled
13	$\frac{d[\text{Fe}^{2+}]}{dt} = \frac{\mu_{\max}[\text{Fe}^{2+}][\text{Fe}^{3+}]}{K_S \left(1 + \frac{[\text{Fe}^{3+}]}{K_P}\right) + [\text{Fe}^{2+}]}$	μ_{\max} , 0.22 h ⁻¹ ; K_S , 0.92 g liter ⁻¹ ; K_P , 4.38 g liter ⁻¹	pH 1.8, 30°C	Nonlinear regression	Chemostat	[Fe(II)]	Competitive inhibition by Fe ³⁺
20	$\frac{d[\text{Fe}^{2+}]}{dt} = \frac{V_{\max}[\text{Fe}^{2+}]X}{K_S \left(1 + \frac{[\text{Fe}^{2+}]}{K_P}\right) + [\text{Fe}^{2+}]}$	V_{\max} [kg (cell h) ⁻¹], (a) 3.8 × 10 ⁻¹⁵ , (b) 2.5 × 10 ⁻¹⁵ ; K_S (g liter ⁻¹), (a) 0.279, (b) 0.268; K_P (g liter ⁻¹), (a) 0.061, (b) 0.352; n , (a) 2.4, (b) 1.9	pH 1.5, 30°C	Linear regression	Initial rates	[Fe(II)]	Competitive inhibition by Fe ³⁺ ; strains of <i>A. ferrooxidans</i> used were ATCC 23270 (a) and T23-3 (b)

^a μ_{\max} , maximum specific growth rate; V_{\max} , maximum specific ferrous iron oxidation rate; q_{\max} , maximum specific oxygen consumption rate. The substrate affinity constant, K_S , and product inhibition constant, K_P , cannot be evaluated on a common basis but must be considered in relation to the specific Monod terms. Models for which two sets (a and b) of constants are reported included a laboratory strain (a) and a mine-isolated strain (b); see the comments for this model for additional strain information.