BioSIM' Development Rate Models

Standardized Parameters

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Scale factor	ψ
Sharpe&all Parameters	H_A, H_L, T_L, T_{k_L}, H_H, T_H, T_{k_H}
General Parameters	k, k_0, k_1, k_2, k_3, k_4
Temperature	T °C $\left(\text{or } T_k \text{ in Kelvin}\right)$
Lower	T_b °C
Optimum	T_o °C
Upper	T_m °C
Others	T_ω
Temperature scale	Δ_T, Δ_{T_b}, Δ_{T_m}
Intermediate computation	β, β_1, β_2, Ω

01• Allahyari (2005)

$$\psi\left(\beta^{k_1}\right)\left(1-\beta^{k_2}\right) \quad \beta = \frac{T - T_b}{T_m - T_b}$$

02• Analytis (1977)

$$\psi\left(T - T_b\right)^{k_1}\left(T_m - T\right)^{k_2}$$

03• Angilletta (2006)

$$\psi\, e^{-\frac{1}{2}\left|\frac{T - T_O}{\Delta T}\right|^{k}}$$

04• Bieri (1983)

$$\left[k_1\left(T - T_b\right)\right] - \left[k_2\, e^{T - T_m}\right]$$

05• Briere1 (1999)

$$\psi\, T\left(T - T_b\right)\left(T_m - T\right)^{\frac{1}{2}}$$

06• Briere2 (1999)

$$\psi\, T\left(T - T_b\right)\left(T_m - T\right)^{\frac{1}{k}}$$

07• Damos (2008)

$$\psi\left(k-\frac{T}{10}\right)\left(\frac{T}{10}\right)^{k}$$

08• Damos (2011)

$$\psi\left(\frac{1}{1+k_1\,T+k_2\,T^2}\right)$$

09• Deutsch (2008)

$$\begin{cases} \psi\left[e^{-k\,(T-T_o)^2}\right] & T \le T_o \\ \psi\left[1-\left(\frac{T-T_o}{T_o-T_m}\right)^2\right] & T > T_o \end{cases}$$

10• Deva&Higgis

$$\psi\left[10^{-\Omega}\left(1-k_2+k_2\,\Omega\right)\right],\ \Omega=\left(\frac{\beta_1+e^{k_1\,\beta_1}}{\beta_2}\right)^2,\quad \beta_1=\left(\frac{T-T_m}{T_m-T_b}\right)-\left(\frac{1}{1+0.28\,k_1+0.72\,\ln(1+k_1)}\right)$$
$$\beta_2=\frac{1+k_1}{1+1.5\,k_1+0.39\,k_1^2}$$

11• Hansen (2011)

$$\psi\left\{\left[e^{k\,(T-T_m)}-1\right]-\left[e^{k\,(T_m-T_b)}-1\right]e^{\left(\frac{T-T_m}{\Delta T}\right)}\right\}$$

12• Hilbert&Logan (1983)

$$\psi\left[\frac{\left(T-T_b\right)^2}{\left(T-T_b\right)^{2+k^2}}-e^{-\frac{T_m-(T-T_b)}{\Delta T}}\right]$$

13• Hilbert&LoganIII

$$\psi\left[\frac{T^2}{T^2+k^2}-e^{-\frac{T_m-T}{\Delta T}}\right]$$

14• Huey&Stevenson (1979)

$$\psi\left(T-T_b\right)\left(1-e^{k\,(T-T_m)}\right)$$

15• Janisch1 (1932)

$$\frac{1}{\psi}\left(\frac{2}{e^{k\,(T-T_o)}+e^{-k\,(T-T_o)}}\right)$$

16• Janisch2 (1932)

$$\frac{1}{\psi}\left(\frac{2}{k_1^{\left(T-T_m\right)}+k_2^{\left(T_m-T\right)}}\right)$$

17• Johnson (1974)

$$\psi\left[\frac{\beta_1\,T_k\,e^{-\frac{k_1}{T_k}}}{1+e^{\left(\beta_2-\frac{k_2}{T_k}\right)}}\right],\ \beta_1=\frac{k_2}{\left(k_2-k_1\right)T_{k_o}\,e^{-\frac{k_1}{T_{k_o}}}},\ \beta_2=\frac{k_2}{T_{k_o}}-\ln\left(\frac{k_2}{k_1}-1\right)$$

18• Kontodimas (2004)

$$\psi\left(T-T_b\right)^2\left(T_m-T\right)$$

19• Lactin1 (1995)

$$e^{k\,T} - e^{\left(k\,T_m - \frac{T_m - T}{\Delta T}\right)}$$

20• Lactin2 (1995)

$$k_1 + e^{k_2\,T} - e^{\left(k_2\,T_m - \frac{T_m - T}{\Delta T}\right)}$$

21• Lamb (1992)

$$\psi\, e^{-\frac{1}{2}\left(\frac{T - T_o}{\Delta T_x}\right)^2},\ \Delta_{T_x} = \begin{cases} \Delta T_1 & T \le T_o \\ \Delta T_2 & T > T_o \end{cases}$$

22• Lobry&Rosso&Flandrois (1993)

$$\psi \frac{\left(T - T_m\right)\left(T - T_b\right)^2}{\left(T_o - T_b\right)\left[\left(T_o - T_b\right)\left(T - T_o\right) - \left(T_o - T_m\right)\left(T_o + T_b - 2\,T\right)\right]}$$

23• Logan10 (1976)

$$\psi\left(\frac{1}{1 + k_1\, e^{-k_2 T}} - e^{-\frac{T_m - T}{\Delta T}}\right)$$

24• Logan6 (1976)

$$\psi\left(e^{k\,T} - e^{\left(k\,T_m - \frac{T_m - T}{\Delta T}\right)}\right)$$

25• LoganTb (1979)

$$\psi\, e^{\left(k\left(T - T_b\right) - e^{k\frac{T - T_b}{\Delta T}}\right)}$$

26• ONeill (1972)

$$\psi\, \beta^{k}\, e^{k\,(1-\beta)},\ \beta = \frac{T_m - T}{T_m - T_o}$$

27• Poly1

$$k_0 + k_1\, T$$

28• Poly2

$$k_0 + k_1\, T + k_2\, T^2$$

29• Poly3

$$k_0 + k_1\, T + k_2\, T^2 + k_3\, T^3$$

30• Poly4

$$k_0 + k_1\, T + k_2\, T^2 + k_3\, T^3 + k_4\, T^4$$

31• Pradham (1946)

$$\psi\, e^{-\frac{1}{2}\left(\frac{T - T_O}{\Delta T}\right)^2}$$

32• Ratkowsky (1983)

$$\psi^2 \left[\left(T - T_b\right)\left(1 - e^{k\left(T - T_m\right)}\right)\right]^2$$

33• Regniere (1982)

$$\psi\left[e^{k\,\beta} - e^{\left(k - \frac{1-\beta}{\Delta T}\right)}\right], \quad \beta = \frac{T - T_b}{T_m - T_b}$$

34• Regniere (1987)

$$\psi\left[\left(\frac{1}{1 + e^{\left(k_1 - k_2\,\beta\right)}}\right) - e^{\left(\frac{\beta - 1}{\Delta T}\right)}\right], \quad \beta = \frac{T - T_b}{T_m - T_b}$$

35• Regniere (2012)

$$\psi\left[e^{k\left(T - T_b\right)} - \left(\left(\frac{T_m - T}{T_m - T_b}\right) e^{-k\left(\frac{T - T_b}{\Delta T_b}\right)}\right) - \left(\frac{T - T_b}{T_m - T_b}\right) e^{k\left(T_m - T_b\right) - \left(\frac{T_m - T}{\Delta T_m}\right)}\right]$$

36• Room (1986)

$$\psi\, e^{-k_x\left(T - T_o\right)^2}, \quad k_x = \begin{cases} k_1 & T \le T_o \\ k_2 & T > T_o \end{cases}$$

37• Saint–Amant (2021)

$$\psi\, e^{\left[-k_1\left(T_\omega - T\right)^2 + \left(\frac{1}{-k_2\left(T_m - T\right)}\right)\right]}$$

38• Schoolfield (1981)

$$\frac{\rho_{25}\left[\frac{T_k}{298}\right] e^{\left(\frac{H_A}{1.987}\right)\left(\frac{1}{298} - \frac{1}{T_k}\right)}}{1 + e^{\left(\frac{H_L}{1.987}\right)\left(\frac{1}{T_L} - \frac{1}{T_k}\right)} + e^{\left(\frac{H_H}{1.987}\right)\left(\frac{1}{T_H} - \frac{1}{T_k}\right)}}$$

39• Sharpe&DeMichele (1977)

$$\frac{\rho_{25}\left[\frac{T_k}{T_{k_o}}\right] e^{\left(\frac{H_A}{1.987}\right)\left(\frac{1}{T_{k_o}} - \frac{1}{T_k}\right)}}{1 + e^{\left(\frac{H_L}{1.987}\right)\left(\frac{1}{T_{kL}} - \frac{1}{T_k}\right)} + e^{\left(\frac{H_H}{1.987}\right)\left(\frac{1}{T_{kH}} - \frac{1}{T_k}\right)}}$$

40• Shi (2011)

$$\psi\left(1 - e^{-k_1\left(T - T_b\right)}\right)\left(1 - e^{k_2\left(T - T_m\right)}\right)$$

41• Shi (2016)

$$\psi\left(\frac{T_m - T}{T_m - T_o}\right)\left(\frac{T - T_b}{T_o - T_b}\right)^{\left(\frac{T_o - T_b}{T_m - T_o}\right)}$$

42• Stinner (1974)

$$\begin{cases} \psi \frac{1}{1+e^{k_1+k_2 T}} & T < T_o \\ \psi \frac{1}{1+e^{k_1+k_2(2\cdot T_o - T)}} & T \geq T_o \end{cases}$$

43• Taylor (1981)

$$\psi\, e^{-\frac{1}{2}\left(\frac{T-T_o}{\Delta T}\right)^2}$$

44• Wagner (1988)

$$\frac{\rho_{25}\left(\frac{T_k}{298.15}\right)e^{\left(\frac{H_A}{1.987}\right)\left(\frac{1}{298.15}-\frac{1}{T_k}\right)}}{1+e^{\left(\frac{H_L}{1.987}\right)\left(\frac{1}{T_L}-\frac{1}{T_k}\right)}}$$

45• Wang&Engel (1998)

$$\psi\left[\frac{2\left(T-T_b\right)^{\beta}\left(T_o-T_b\right)^{\beta}-\left(T-T_b\right)^{2\cdot\beta}}{\left(T_o-T_b\right)^{2\cdot\beta}}\right],\quad \beta=\frac{\ln(2)}{\ln\left(\frac{T_m-T_b}{T_o-T_b}\right)}$$

46• Wang&Lan&Ding (1982)

$$\psi\left(\frac{1}{1+e^{-k\left(T-T_o\right)}}\right)\left(1-e^{-\frac{T-T_b}{\Delta T}}\right)\left(1-e^{-\frac{T_m-T}{\Delta T}}\right)$$

47• Yan&Hunt (1999)

$$\psi\left(\frac{T_m-T}{T_m-T_o}\right)\left(\frac{T}{T_o}\right)^{\frac{T_o}{T_m-T_o}}$$

48• Yin (1995)

$$e^{\psi}\left(T-T_b\right)^{k_1}\left(T_m-T\right)^{k_2}$$

Reference

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