Development of Equations for the Bacterial Growth Model

Exponential bacterial growth - due to bacteria fission:

$$\frac{\mathrm{d}c(t)}{\mathrm{d}t} = kc \rightarrow \Delta c = kc\Delta t$$

Bacterial growth regarding temperature dependence - inactivation rate k at specific temperature T in reference to 20degree outside and a chosen water source (see [1]):

$$\frac{k}{k_{20}} = Q_{10}^{(T-T_{20})/10} \rightarrow k = k_{20} * Q_{10}^{(T-T_{20})/10}$$

Bacterial concentration in water tank (compare [4] - Pollution concentration in liquid tank):

$$c = \frac{Q_{in}c_{in}\Delta t + Vc - Q_{out}c\Delta t}{Q_{in}\Delta t + V - Q_{out}\Delta t} \rightarrow \Delta c = \frac{Q_{in}c_{in}\Delta t + Vc - Q_{out}c\Delta t}{Q_{in}\Delta t + V - Q_{out}\Delta t} - c$$

$$\rightarrow \mathrm{d}c = \frac{Q_{in}c_{in}\,\mathrm{d}t + Vc - Q_{out}c\,\mathrm{d}t}{Q_{in}\,\mathrm{d}t + V - Q_{out}\,\mathrm{d}t} - c$$

Bacterial concentration in water tank and bacterial growth:

$$\Delta c = \frac{Q_{in}c_{in}\Delta t + Vc - Q_{out}c\Delta t}{Q_{in}\Delta t + V - Q_{out}\Delta t} + kc\Delta t - c$$

$$\rightarrow \mathrm{d}c = \frac{Q_{in}c_{in}\,\mathrm{d}t + Vc - Q_{out}c\,\mathrm{d}t}{Q_{in}\,\mathrm{d}t + V - Q_{out}\,\mathrm{d}t} + kc\,\mathrm{d}t - c$$

Combination - bacteria concentration in water tank and bacterial growth including inaktivation rate k depending on temperature:

$$\Delta c = \frac{Q_{in}c_{in}\Delta t + Vc - Q_{out}c\Delta t}{Q_{in}\Delta t + V - Q_{out}\Delta t} + kc\Delta t - c$$

$$\rightarrow \mathrm{d}c = \left[\left(\frac{Q_{in}c_{in}\,\mathrm{d}t + Vc - Q_{out}c\,\mathrm{d}t}{Q_{in}\,\mathrm{d}t + V - Q_{out}\,\mathrm{d}t}\right) + \left(k_{20}Q_{10}^{(T-T_{20})/10}c\right)\mathrm{d}t\right] - c$$