

Example 4.3

Calculate the alkalinity change for the activated sludge process represented in Example 4.1. Estimate the alkalinity change in the process if denitrification would not occur.

Solution:

With the aid of Eq. (4.18) and Table 4.1 the total alkalinity change is calculated as:

$$\begin{aligned}\Delta\text{Alk}_t &= 3.57 \cdot (\Delta N_a - \Delta N_n) = 3.57 \cdot (N_{ae} - N_{ai} - (N_{ne} - N_{ni})) \\ &= 3.57 \cdot (0.0 - 32.8 - (8.7 - 0.3)) = -147 \text{ mg CaCO}_3 \cdot \text{l}^{-1}\end{aligned}$$

Without denitrification the alkalinity changes only due to ammonification and nitrification and can be calculated as follows. The nitrogen concentration in the excess sludge is estimated as $N_l = f_n \cdot R_n \cdot X_w / R_s = 8.6 \text{ mg N} \cdot \text{l}^{-1}$, so that by using Table 4.2 one has:

$$\begin{aligned}\Delta N_{am} &= N_{oi} - N_{oe} - N_l \\ &= (45.1 - 32.8) - (1.9 - 0.0) - 8.6 = 12.3 - 1.9 - 8.6 = 1.8 \text{ mg N} \cdot \text{l}^{-1}\end{aligned}$$

The effect of ammonification on the alkalinity change is now calculated:

$$\begin{aligned}\Delta\text{Alk}_a &= 3.57 \cdot N_{am} \\ &= 3.57 \cdot 1.8 = 6 \text{ mg CaCO}_3 \cdot \text{l}^{-1}\end{aligned}$$

The nitrified ammonium concentration is calculated as:

$$\begin{aligned}N_c &= N_{ki} - N_{ke} - N_l \\ &= 45.1 - 1.9 - 8.6 = 34.6 \text{ mgN} \cdot \text{l}^{-1}\end{aligned}$$

$$\Delta\text{Alk}_n = -7.14 \cdot N_c = -247 \text{ mg CaCO}_3 \cdot \text{l}^{-1}$$

Hence, without denitrification the alkalinity change would amount to:

$$\Delta\text{Alk}_t = \Delta\text{Alk}_{am} + \Delta\text{Alk}_n = 6 - 247 = -241 \text{ mg CaCO}_3 \cdot \text{l}^{-1}$$

Example 4.4

What would be the minimum required alkalinity of the sewage in the system of Example 4.1 to ensure a stable and neutral pH value?

Solution:

In Table 4.1 it can be noted that $N_{ai} = 32.8$; $N_{ae} = 0.0$; $N_{ni} = 0.3$ and $N_{ne} = 8.7 \text{ mg N} \cdot \text{l}^{-1}$. Hence by using Eq. (4.27) the minimum influent alkalinity is calculated as:

$$\text{Alk}_i > 3.57 \cdot (8.7 - 0.3 - (0.0 - 32.8)) + 10 = 183 \text{ ppm CaCO}_3$$