

Example 4.6

Verify if the experimentally observed nitrate removal in the previous example corresponds to the calculated denitrification capacity. Estimate the denitrification capacity for two configurations (a) the last two reactors are anoxic (post-D configuration) and (b) the first and fourth reactor are anoxic (Bardenpho configuration).

Solution:

In Example 4.1 the daily removed nitrate mass was calculated as $864 \text{ g N}\cdot\text{d}^{-1}$. As the influent flow is $40 \text{ m}^3\cdot\text{d}^{-1}$, the experimentally observed nitrate removal is $864/40 = 21.6 \text{ mg N}\cdot\text{l}^{-1}$. This value corresponds to 88 percent of the calculated value of the denitrification capacity of $24.6 \text{ mg N}\cdot\text{l}^{-1}$.

The denitrification capacity for the post-D configuration is equal to:

$$D_{c3} = k_3 \cdot C_r \cdot f_{x3} \cdot S_{bi} = 0.08 \cdot (1.03)^{1.6} \cdot 1.45 \cdot 0.4 \cdot 430 = 21 \text{ mg N}\cdot\text{l}^{-1}$$

For the Bardenpho configuration:

$$D_c = D_{c1} + D_{c3} = 24.5 + 21/2 = 35 \text{ mg N}\cdot\text{l}^{-1}$$

When comparing the denitrification capacity in the post-D reactor ($21/2 = 10.5 \text{ mg N}\cdot\text{l}^{-1}$ per reactor) with the value calculated in the pre-D reactor in example 4.5 ($24.3 \text{ mg N}\cdot\text{l}^{-1}$), it is concluded that under the specified conditions, the pre-D reactor removes more than twice the amount of nitrate of the post-D reactor. It is interesting to compare the denitrification capacity of the Bardenpho configuration with the nitrification capacity. N_c can be calculated with the aid of Eq. (4.43):

$$N_c = N_{ni} + N_{ni} - N_l - N_{le} = 45.1 + 0.3 - 343/40 - 1.9 = 34.9 \text{ mg N}\cdot\text{l}^{-1}$$

The denitrification capacity ($35 \text{ mg N}\cdot\text{l}^{-1}$) is marginally larger than the nitrification capacity in the Bardenpho configuration ($34.9 \text{ mg N}\cdot\text{l}^{-1}$). Thus in principle it is possible to produce an effluent with a very low nitrate concentration. However, to do so, it will be required to introduce a recirculation flow from the aerobic- to the pre-D reactor.