

4.2.5 Nitrification potential and nitrification capacity

The nitrification potential is defined as the TKN concentration in the influent that can be nitrified, i.e. is available for nitrification. This concentration can be expressed as:

$$N_p = N_{ki} - N_{oe} - N_l \quad (4.41)$$

Where:

$$\begin{aligned} N_p &= \text{nitrification potential (mg N.l}^{-1}\text{)} \\ N_{ki} &= \text{influent TKN concentration (mg N.l}^{-1}\text{)} \\ N_l &= \text{nitrogen concentration required for sludge production (mg N.l}^{-1}\text{)} \\ N_{oe} &= \text{organic nitrogen in the effluent (mg N.l}^{-1}\text{)} \end{aligned}$$

To reduce the model complexity as much as possible, the N_{oe} fraction is assumed to contain both the soluble and the particulate organic nitrogen. In fact, the particulate organic nitrogen fraction is part of the nitrogen present in the produced excess sludge N_l , in this case leaving with the effluent because of imperfect solid-liquid separation in the final settler. The consequences of this modelling decision are small. The value of N_l has been determined previously with Eq. (3.61). Using this expression in Eq. (4.41) one has:

$$N_p = N_{ki} - N_{oe} - f_n \cdot [(1 - f_{ns} - f_{np}) \cdot (1 + f \cdot b_h \cdot R_s) \cdot C_r / R_s + f_{np} / f_{cv}] \cdot S_{ti} \quad (4.42)$$

The nitrification capacity is defined as the influent TKN concentration that is effectively nitrified in the activated sludge process. Hence the nitrification capacity is the difference between the nitrification potential and the effluent ammonium concentration.

$$N_c = N_p - N_{ae} \quad (4.43)$$

Where N_c = nitrification capacity (mg N.l⁻¹)

Using Eq. (4.37) for N_a and Eq. (4.42) for N_p the following equation is derived:

$$N_c = N_{ki} - N_{oe} - f_n \cdot [(1 - f_{ns} - f_{np}) \cdot (1 + f \cdot b_h \cdot R_s) \cdot C_r / R_s + f_{np} / f_{cv}] \cdot S_{ti} - K_n \cdot (b_n + 1/R_s) / [\mu_m \cdot (1 - f_x) - (b_n + 1/R_s)] \quad (4.44)$$

Fig. 4.11 shows the values of N_p , N_c and f_m as function of the sludge age for the following conditions:

- Composition and concentration of the influent organic matter (used to calculate N_l):
 $f_{ns} = f_{np} = 0.1$ and $S_{ti} = 500$ mg COD.l⁻¹;
- Nitrification kinetic parameters: $\mu_m = 0.3$ d⁻¹ (Fig 4.11.a) and 0.6 d⁻¹ (Fig. 4.11.b);
 $K_n = 1.0$ mg N.l⁻¹; $b_n = 0.04$ d⁻¹; $N_{ad} = 2$ mg N.l⁻¹ and $f_{max} = 0.6$;
- Influent nitrogen concentration: $N_{ni} = 0$ mg N.l⁻¹ and $N_{ki} = N_{ti} = 50$ mg N.l⁻¹.

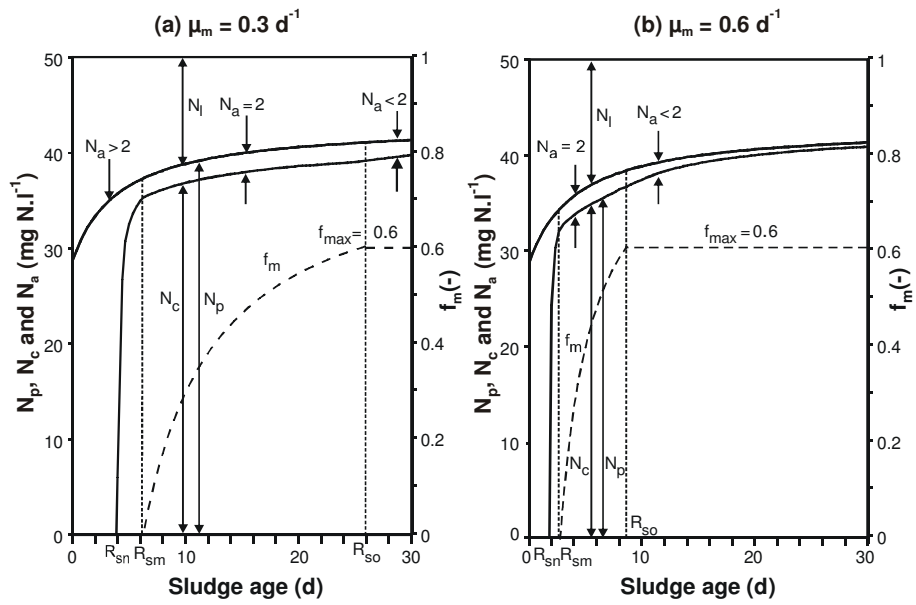


Figure 4.11 Values of N_c, N_p, N_i, and N_a as a function of the sludge age for different values of μ_m . The values R_{sn} (f_m = 0) and R_{so} (f_m = f_{max}) are indicated as well