3.2.4.2 Biological reactor volume

In the previous section it was established that in a steady state activated sludge system a sludge mass will develop that is compatible with the daily applied COD load. When the sludge mass of the system is known, the reactor volume can be calculated after defining the sludge concentration (X_v or X_t) that is to be maintained:

$$V_r = (MX_v)/X_v$$
$$= [(1 - f_{ns} - f_{np})\cdot(1 + f\cdot b_h\cdot R_s)\cdot C_r + f_{np}\cdot R_s/f_{cv}]\cdot Q_i\cdot S_{ti}/X_v \quad (3.55)$$

The volume per unit mass daily applied COD can be expressed as:

$$v_r = V_r/(Q_i\cdot S_{ti}) = mX_v/X_v$$
$$= [(1 - f_{ns} - f_{np})\cdot(1 + f\cdot b_h\cdot R_s)\cdot C_r + f_{np}\cdot R_s/f_{cv}]/X_v \quad (3.56)$$

Fig. 3.9 shows the biological reactor volume per unit mass daily applied COD as a function of the sludge age for different sludge concentrations for typical values of both raw and settled sewage. Equation (3.56) shows that the volume per unit mass daily applied COD depends on the following factors:

- Sludge concentration;
- Sludge age;
- Composition of organic material (f_{ns} and f_{np});
- Temperature (influences b_h).

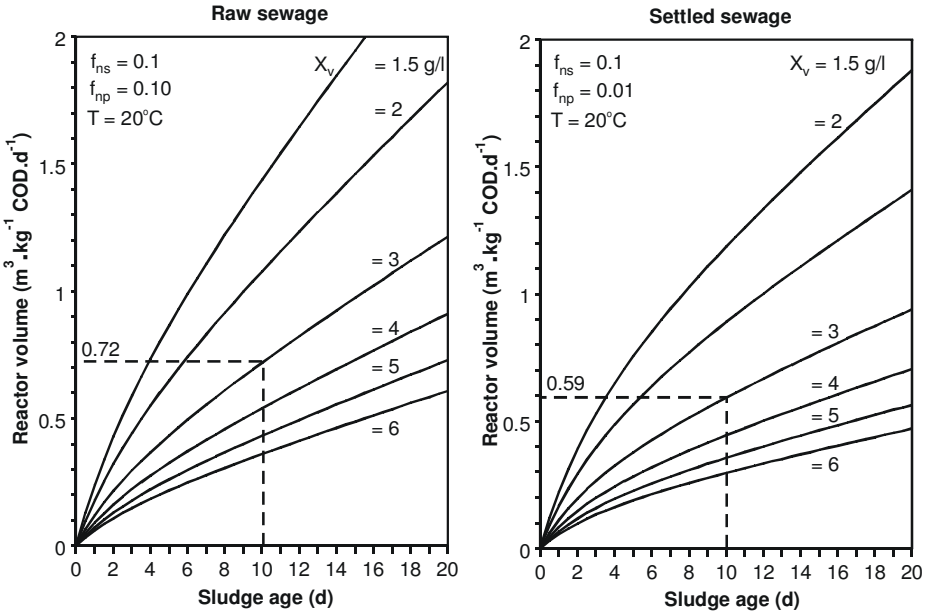

Figure 3.9 Volume of the biological reactor of an activated sludge system per unit mass daily applied COD as a function of the sludge age for different sludge concentrations for raw (a) and settled (b) sewage

In the case of municipal sewage it is possible to calculate the volume per capita, if the COD contribution per inhabitant is known:

$$V_{inh} = S_h \cdot v_r \quad (3.57)$$

Where:

V_{inh} = required reactor volume per inhabitant
S_h = daily COD contribution per inhabitant