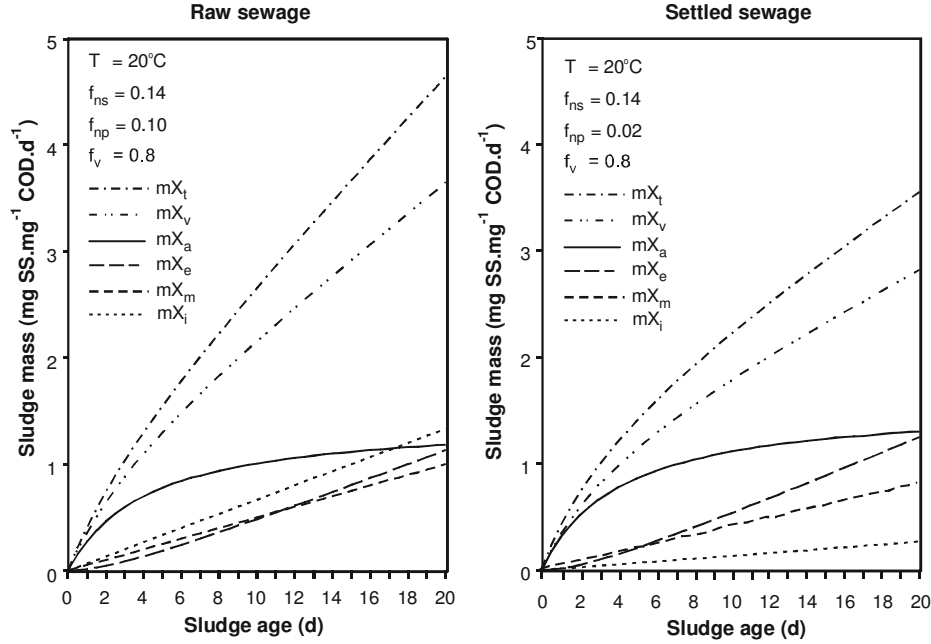


### 3.2.4.1 Sludge mass and composition

The mass equations from Table 3.5 can be used to calculate the masses of the different fractions that compose the sludge as a function of the sludge age, when the daily organic load is known. In Fig. 3.7, the masses of inert, active, endogenous, organic and total sludge per unit mass of daily applied COD ( $mX_i$ ,  $mX_a$ ,  $mX_e$ ,  $mX_v$  and  $mX_t$ ) are plotted as functions of the sludge age for raw sewage ( $f_{np} = 0.10$  and  $f_{ns} = 0.14$ ) and settled sewage ( $f_{np} = 0.02$  and  $f_{ns} = 0.14$ ).



**Figure 3.7** Sludge masses per unit mass daily applied COD for the different sludge components for raw and settled sewage

The figures show two important aspects: (1) the sludge mass depends heavily on the characteristics of the influent organic material and (2) the active sludge fraction decreases with increasing sludge age. Since the active sludge fraction is an important parameter, it is interesting to derive an expression for it. The active sludge fraction can either be defined as a fraction of the organic or total sludge concentration:

$$f_{av} = mX_a/mX_v = (1 - f_{ns} - f_{np}) \cdot C_r / [(1 - f_{ns} - f_{np}) \cdot (1 + f \cdot b_h \cdot R_s) \cdot C_r + f_{np} \cdot R_s / f_{cv}] \quad (3.53)$$

$$f_{at} = mX_a/mX_t = (1 - f_{ns} - f_{np}) \cdot C_r / [(1 - f_{ns} - f_{np}) \cdot (1 + f \cdot b_h \cdot R_s) \cdot C_r + f_{np} \cdot R_s / f_{cv}] \cdot f_v = f_{av} \cdot f_v \quad (3.54)$$

Where:

- $f_{av}$  = ratio between the active and volatile sludge mass
- $f_{at}$  = ratio between the active and total sludge mass
- $f_v$  = ratio between the volatile and total sludge mass

Fig. 3.8 shows values of  $f_{av}$  and  $f_{at}$  as functions of the sludge age for raw and settled sewage. It can be noted in Fig. 3.8 that the active sludge fraction depends strongly on the composition of the influent organic material. For example, for raw sewage the active sludge fraction is  $f_{av} = 0.45$  at a sludge age of 10 days. In the case of settled sewage, for the same sludge age the active fraction is much higher:  $f_{av} = 0.63$ . In the case of settled sewage an active fraction  $f_{av} = 0.45$  is only possible for a sludge age of more than 20 days.

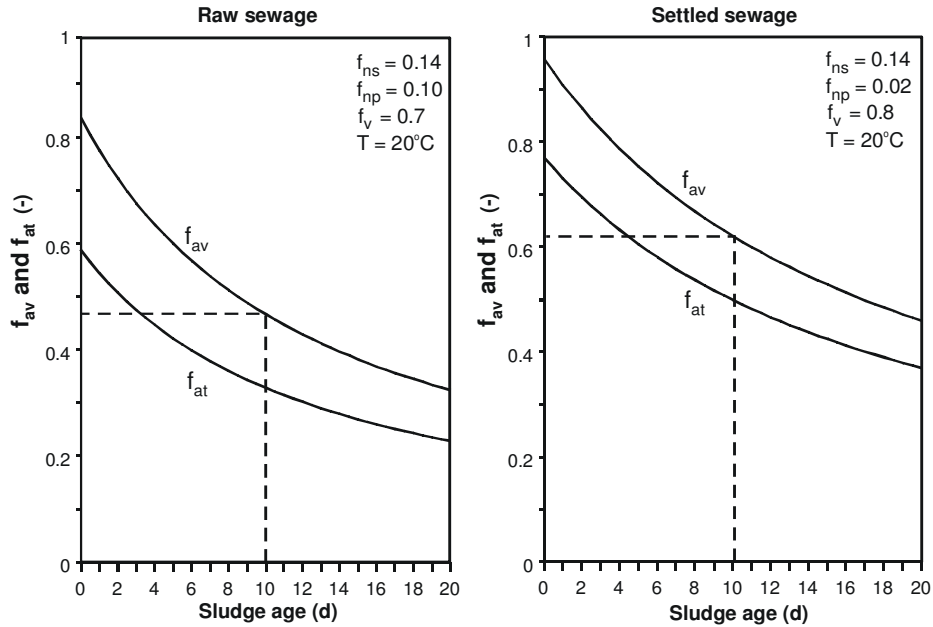


Figure 3.8 Active sludge fraction as a function of the sludge age for raw and settled sewage