

**Example 3.6**

An activated sludge system is designed to contain a maximum sludge mass of  $3.0 \text{ mg VSS} \cdot \text{mg}^{-1} \text{ COD} \cdot \text{d}^{-1}$ . If the non-biodegradable fractions are  $f_{ns} = f_{np} = 0.10$ , calculate for  $14^\circ\text{C}$  and for  $28^\circ\text{C}$ : (a) the maximum sludge age, (b) the oxygen consumption and (c) the active sludge fraction for this maximum sludge age.

**Solution:**

The maximum sludge age for  $mX_v = 3.0 \text{ mg VSS} \cdot \text{mg}^{-1} \text{ COD} \cdot \text{d}^{-1}$  can be calculated from Eq. (3.50) or read off in Fig. 3.11b. For the specific  $f_{ns}$  and  $f_{np}$  values, one has for  $mX_v = 3.0$  and  $T = 14^\circ\text{C}$  a sludge age of  $R_s = 14$  days and for  $T = 28^\circ\text{C}$  a value of  $R_s = 16.5$  days. In Fig. 3.11a it can be seen that the oxygen consumption per unit mass influent COD is  $mS_o = 0.62$  for  $T = 28^\circ\text{C}$  and  $R_s = 16.5$  days and  $mS_o = 0.58$  for  $T = 14^\circ\text{C}$  and  $R_s = 14$  days. It is concluded that in the same system and maintaining the same volatile sludge concentration an increase of temperature from  $14$  to  $28^\circ\text{C}$  causes an increase of the oxidised COD fraction from  $58$  to  $62$  percent, due to a higher endogenous respiration rate; an increase of  $(62 - 58)/58 = 7$  percent or  $0.5$  percent per  $^\circ\text{C}$ .

In general the oxygenation capacity of an aerator tends to decrease with increasing temperature (due to the decrease of oxygen solubility), so that the oxygenation capacity must be designed for the highest temperature to be expected. Alternatively the process can also be operated at a shorter sludge age when the temperature increases.

The active sludge fraction is calculated from Eq.(3.53):  $f_{av} = 0.45$  for  $R_s = 14$  d and  $T = 14^\circ\text{C}$  and  $f_{av} = 0.32$  for  $R_s = 16.5$  d and  $T = 28^\circ\text{C}$ . Hence there is a considerable reduction of the active sludge fraction due to the higher decay rate when temperature increases. However, since the metabolic capacity of the sludge increases with increasing temperature, the treatment capacity of the system may actually increase.