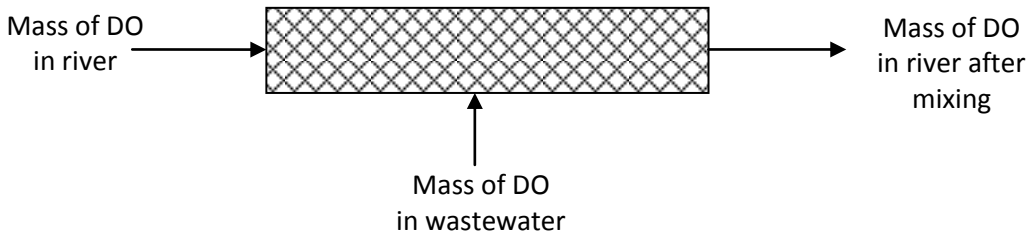
Sixth lecture Water resources and their characterization- river 3

Mass balance approach :

Simplified mass balance help us understand and solve DO sag curve problem. DO, BOD and Temperature used to account for initial mixing of the waste stream and the river. Mass balance diagram for DO is shown as:



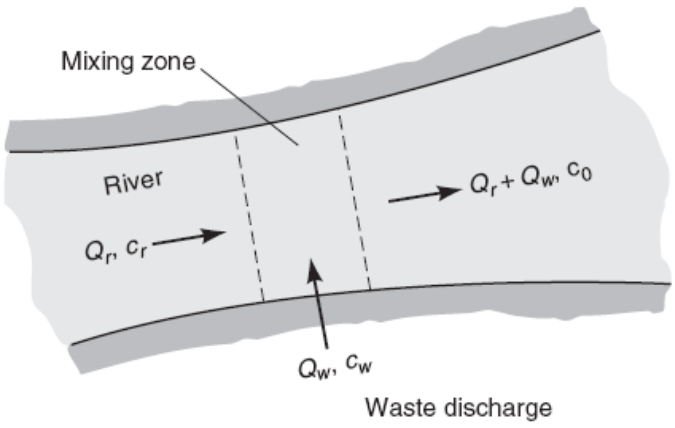
The product of the water flow and the DO concentration yields a mass of oxygen per unit time:

Mass of DO in wastewater = Q_w x DO_w
Mass of DO in river = Q_r x DO_r

Where: Q_w = flow rate of wastewater (m^3/s)
Q_r = flow rate of river (m^3/s)
DO_w = DO concentration in the wastewater (g/m^3)
DO_r = DO concentration in the river (g/m^3)

The mass of DO in the water after mixing equals sum of the mass flows:

$$\text{Mass of DO after mixing} = Q_w \times DO_w + Q_r \times DO_r$$



In a similar fashion for BOD_u :

$$\text{Mass of BOD after mixing} = Q_w \times L_w + Q_r \times L_r$$

Where : Lw = BOD_u for the wastewater (mg/l)
Lr = BOD_u for the river (mg/l)

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The concentration of DO and BOD_u after mixing are :

$$DO\left(\frac{mg}{l}\right) = \frac{Q_w\, DO_w + Q_r\, DO_r}{Q_w + Q_r} \quad \text{---------- eq1}$$

$$La\left(\frac{mg}{l}\right) = \frac{Q_w\, L_w + Q_r\, L_r}{Q_w + Q_r} \quad \text{---------- eq2}$$

Where: La = initial BOD_u after mixing (mg/l)

For temperature

$$T_m = \frac{Q_w\, T_w + Q_r\, T_r}{Q_w + Q_r} \quad \text{---------- eq3}$$

Example: The dissolved-oxygen concentration in a river upstream of a municipal wastewater outfall is 10 mg/L. (a) if the *Q* river flow upstream of the outfall is $50m^3/s$, and the outfall discharges $2m^3/s$ of wastewater with a dissolved-oxygen concentration of 1 mg/L, estimate the dissolved-oxygen concentration in the river after complete mixing. (b) if the upstream river temperature is 10 C° and the wastewater temperature is 20 C°, estimate the temperature of the mixed river water?