



Problem 1.-

As the intervals are regular (2h):

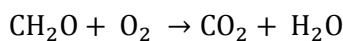
$$\text{Average } Q = \frac{\sum Q_i}{\text{number of samples}} = 800 \text{ L/s}$$

As flow rates are not regular:

$$\text{Average } SS = \frac{\sum Q_i \cdot SS_i}{\sum Q_i} = 190.5 \text{ mg SS/L}$$

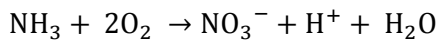
Problem 2.-

- 300 mg/L CH₂O simple carbohydrate:



$$300 \frac{\text{mg CH}_2\text{O}}{\text{L}} \cdot \frac{1 \text{ g}}{10^3 \text{ mg}} \cdot \frac{1 \text{ mol CH}_2\text{O}}{30 \text{ g}} \cdot \frac{1 \text{ mol O}_2}{1 \text{ mol CH}_2\text{O}} \cdot \frac{32 \text{ g O}_2}{1 \text{ mol O}_2} \cdot \frac{10^3 \text{ mg}}{1 \text{ g}} = 320 \text{ mg} \frac{\text{O}_2}{\text{L}}$$

- 50 mg/L N as NH₃ simple carbohydrate:



$$50 \frac{\text{mg N}}{\text{L}} \cdot \frac{1 \text{ g}}{10^3 \text{ mg}} \cdot \frac{17 \text{ g NH}_3}{14 \text{ g N}} \cdot \frac{1 \text{ mol NH}_3}{2 \text{ mol O}_2} \cdot \frac{32 \text{ g O}_2}{1 \text{ mol O}_2} \cdot \frac{10^3 \text{ mg}}{1 \text{ g}} = 228.6 \text{ mg} \frac{\text{O}_2}{\text{L}}$$

Sum of both demands:

$$320 \text{ mg} \frac{\text{O}_2}{\text{L}} + 228.6 \text{ mg} \frac{\text{O}_2}{\text{L}} = 548.6 \text{ mg} \frac{\text{O}_2}{\text{L}}$$

ThOD (if $\Delta T = 5^\circ\text{C}$) = 548.6 mg O₂/L

It does not depend on the temperature.



Problem 3.-

40 mg/L phenol; MW (C₆H₅OH) = 94 g/mol

350 mg/L glucose; MW (C₆H₁₂O₆) = 180 g/mol

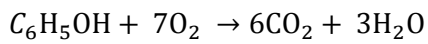
3 mg/L sulphur; MW (S²⁻) = 32 g/mol

50 mg/L methanol; MW (CH₃OH) = 32 g/mol

100 mg/L non-bio compound; MW (C₉H₁₄O) = 138 g/mol

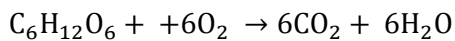
a) Chemical Oxygen Demand (COD)

Phenol:



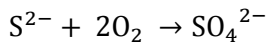
$$COD = 95.319 \text{ mg O}_2/\text{L}$$

Glucose:



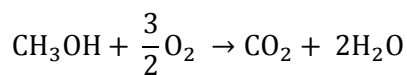
$$COD = 373.33 \text{ mg O}_2/\text{L}$$

Sulphur:



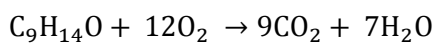
$$COD = 6 \text{ mg O}_2/\text{L}$$

Methanol:



$$COD = 75 \text{ mg O}_2/\text{L}$$

Non-biodegradable compound



$$COD = 278.26 \text{ mg O}_2/\text{L}$$

$$\text{Total COD} = 827.91 \text{ mg O}_2/\text{L}$$

b) Biological Oxygen Demand (BOD₅)

$$BOD_{\max} = 827.91 - 278.26 \text{ (non - biodegradable)} = 549.65 \text{ mg } \frac{O_2}{L}$$



$$\text{BOD}_5 = 549.65 \text{ mg} \frac{\text{O}_2}{\text{L}} (1 - e^{-0.23 \text{ days}^{-1} \cdot 5 \text{ days}}) = 375.612 \frac{\text{mg O}_2}{\text{L}}$$

Problem 4.-

River mass balance:

- 1: River parameters before discharge
- 2: River parameters after discharge

$$Q_1 \cdot \text{BOD}_{5_1} + Q_{\text{discharge}} \cdot \text{BOD}_{5_{\text{discharge}}} = Q_2 \cdot \text{BOD}_{5_2}$$

$$\frac{100 \text{ L}}{\text{s}} \cdot \frac{0 \text{ mg O}_2}{\text{L}} + Q_{\text{discharge}} \cdot \frac{20 \text{ mg O}_2}{\text{L}} = \left(\frac{100 \text{ L}}{\text{s}} + Q_{\text{discharge}} \right) \cdot \frac{4 \text{ mg O}_2}{\text{L}}$$

$$Q_{\text{discharge}} = 25 \frac{\text{L}}{\text{s}}$$

$$\frac{400 \text{ L}}{\text{hab} \cdot \text{day}} \cdot \frac{1 \text{ day}}{24 \text{ h}} \cdot \frac{1 \text{ h}}{3600 \text{ s}} = 2.16 \cdot 10^6 \frac{\text{L}}{\text{s} \cdot \text{hab}}$$

$$25 \frac{\text{L}}{\text{s}} \div 2.16 \cdot 10^6 \frac{\text{L}}{\text{s} \cdot \text{hab}} = 5400 \text{ inhabitants}$$