

UNIVERSITY OF CANTABRIA
DEPARTMENT OF SCIENCE AND TECHNIQUES OF WATER AND THE ENVIRONMENT

Water pollution

EXAMPLE 1

If the BOD_3 of a wastewater is 75 mg/L, and $k_1 = 0.345 \text{ d}^{-1}$, what is the ultimate BOD?

$$BOD_t = BOD_u(1 - e^{-k_1 \cdot t})$$

$$BOD_7 = BOD_u(1 - e^{-0,345 \cdot 7})$$

$$BOD_u = \frac{75}{1 - e^{-0,345 \cdot 7}} = 120 \text{ mg O}_2/\text{L}$$

EXAMPLE 2

An industry generates 20,000 m³/year, with an average BOD₅ concentration of 1000 mg/L. Calculate the population equivalent of the industry.

$$1 \text{ P.E.} = 60 \text{ g BOD}_5/\text{d}$$

$$20,000 \text{ m}^3/\text{yr} * (1000 \text{ L/m}^3) / (365 \text{ d/yr}) = 54794.5 \text{ L/d}$$

$$54794.5 \text{ L/d} * 1000 \text{ mg/L} * 1 / (1000 \text{ mg/g}) = 54794.5 \text{ g BOD}_5/\text{d}$$

$$\text{P.E.} = (54794.5 \text{ g BOD}_5/\text{d}) / (60 \text{ g BOD}_5/\text{d/inhabitant}) = \mathbf{913 \text{ inhabitants}}$$

EXAMPLE 3

After analyzing 50 mL water samples, the following results are obtained:

After evaporation, residual weights	30 mg
After filtration, the material retained and evaporated weights	10 mg
The material retained in the filter is ignited and it weights	7 mg

Determine DS and VSS

Solution:

$$DS = TS - SS = (30 - 10) \text{ mg}/50 \text{ mL} * 1000 \text{ mL}/\text{L} = 400 \text{ mg}/\text{L}$$

$$VSS = SS - FSS = (10 - 7) \text{ mg}/50 \text{ mL} * 1000 \text{ mL}/\text{L} = 60 \text{ mg}/\text{L}$$

EXAMPLE 4

After analyzing a water sample, the following results are obtained:

$$\text{TS} = 500 \text{ mg/L}$$

$$\text{TSS} = 450 \text{ mg/L}$$

$$\text{FSS} = 100 \text{ mg/L}$$

$$\text{FDS} = 40 \text{ mg/L}$$

Determine:

1. Obtain TFS
2. Which is approximately the percentage of all solids that are organic? And inorganic?
3. Which is approximately the percentage of TSS that are organic? And inorganic?
4. This water is settled. Then, TS removal by settling can be 95%?
5. What percentage of solids can be removed by filtration?

Solution:

1. $\text{TFS} = \text{FSS} + \text{FDS} = 100 + 40 = 140 \text{ mg/L}$
2. Organic \approx volatile; $\text{TVS} = \text{TS} - \text{TFS} = 500 - 140 = 360 \text{ mg/L}$
 $\text{TVS}/\text{TS} = 360/500 = 72\%$ (organic solids)
 $\text{TFS}/\text{TS} = 140/500 = 28\%$ (inorganic solids)
3. $\text{VSS} = \text{TSS} - \text{FSS} = 450 - 100 = 350 \text{ mg/L}$;
 $\text{VSS}/\text{TSS} = 78\%$ (organic SS)
 $\text{FSS}/\text{TSS} = 100/450 = 22\%$ (inorganic SS)
4. Only a fraction of TSS can settle; $\text{TSS}/\text{TS} = 90\%$ (it cannot be 95%)
5. Only TSS can be removed by filtration; $\text{TSS}/\text{TS} = 90\%$