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Disposing of the Sewage Effluents Formulas

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List of 33 Disposing of the Sewage Effluents Formulas

Disposing of the Sewage Effluents

1) Actual Dissolved Oxygen

Open Calculator

fx $A_{DO} = S_{DO} - D$

ex $4.8\text{mg/L} = 9\text{mg/L} - 4.2\text{mg/L}$

2) Mixing Concentration

Open Calculator

fx $C = \frac{C_s \cdot Q_s + C_R \cdot Q_{stream}}{Q_s + Q_{stream}}$

ex $1.2 = \frac{0.2 \cdot 10\text{m}^3/\text{s} + 1.3 \cdot 100\text{m}^3/\text{s}}{10\text{m}^3/\text{s} + 100\text{m}^3/\text{s}}$

3) River Stream Concentration

Open Calculator

fx $C_R = \frac{C \cdot (Q_s + Q_{stream}) - (C_s \cdot Q_s)}{Q_{stream}}$

ex $1.3 = \frac{1.2 \cdot (10\text{m}^3/\text{s} + 100\text{m}^3/\text{s}) - (0.2 \cdot 10\text{m}^3/\text{s})}{100\text{m}^3/\text{s}}$

4) River Stream Flow Rate

Open Calculator

fx $Q_{stream} = \frac{(C_s \cdot Q_s) - (C \cdot Q_s)}{C - C_R}$

ex $100\text{m}^3/\text{s} = \frac{(0.2 \cdot 10\text{m}^3/\text{s}) - (1.2 \cdot 10\text{m}^3/\text{s})}{1.2 - 1.3}$

5) Saturated Dissolved Oxygen

Open Calculator

fx $S_{DO} = D + A_{DO}$

ex $9\text{mg/L} = 4.2\text{mg/L} + 4.8\text{mg/L}$

6) Sewage Concentration

Open Calculator

$$C_s = \frac{C \cdot (Q_s + Q_{stream}) - (C_R \cdot Q_{stream})}{Q_s}$$

$$0.2 = \frac{1.2 \cdot (10m^3/s + 100m^3/s) - (1.3 \cdot 100m^3/s)}{10m^3/s}$$

7) Sewage Flow Rate

Open Calculator

$$Q_s = \frac{(C_R - C) \cdot Q_{stream}}{C - C_s}$$

$$10m^3/s = \frac{(1.3 - 1.2) \cdot 100m^3/s}{1.2 - 0.2}$$

Critical Oxygen Deficit

8) Critical Oxygen Deficit

Open Calculator

$$D_c = K_D \cdot L_t \cdot \frac{10^{-K_D \cdot t_c}}{K_R}$$

$$0.000168 = 0.23d^{-1} \cdot 0.21mg/L \cdot \frac{10^{-0.23d^{-1} \cdot 0.5d}}{0.22d^{-1}}$$

9) Critical Oxygen Deficit given Self Purification Constant

Open Calculator

$$D_c = L_t \cdot \frac{10^{-K_D \cdot t_c}}{f}$$

$$0.000179 = 0.21mg/L \cdot \frac{10^{-0.23d^{-1} \cdot 0.5d}}{0.9}$$

10) Critical Oxygen Deficit in First Stage Equation

Open Calculator

$$D_c = \frac{\left(\frac{L_t}{f}\right)^f}{1 - (f - 1) \cdot D_o}$$

$$0.000538 = \frac{\left(\frac{0.21mg/L}{0.9}\right)^{0.9}}{1 - (0.9 - 1) \cdot 7.2mg/L}$$

Critical Time

11) Critical Time

Open Calculator

$$t_c = \left(\frac{1}{K_R - K_D}\right) \cdot \log 10\left(\left(\frac{K_D \cdot L_t - K_R \cdot D_o + K_D \cdot D_o}{K_D} \cdot L_t\right) \cdot \left(\frac{K_R}{K_D}\right)\right)$$

ex

$$697.8548\text{d} = \left(\frac{1}{0.22\text{d}^{-1} - 0.23\text{d}^{-1}}\right) \cdot \log 10\left(\left(\frac{0.23\text{d}^{-1} \cdot 0.21\text{mg/L} - 0.22\text{d}^{-1} \cdot 7.2\text{mg/L} + 0.23\text{d}^{-1} \cdot 7.2\text{mg/L}}{0.23\text{d}^{-1}} \cdot 0.\right.$$

12) Critical Time given Self Purification Constant with Critical Oxygen Deficit

Open Calculator

$$t_c = \log 10\frac{D_c \cdot \frac{f}{L_t}}{K_D}$$

ex

$$0.474541\text{d} = \log 10\frac{0.0003 \cdot \frac{0.9}{0.21\text{mg/L}}}{0.23\text{d}^{-1}}$$

13) Critical Time given Self Purification Factor

Open Calculator

$$t_c = -\left(\log 10\frac{1 - (f - 1) \cdot \left(\frac{D_c}{L_t}\right) \cdot f}{K_D \cdot (f - 1)}\right)$$

ex

$$2.283872\text{d} = -\left(\log 10\frac{1 - (0.9 - 1) \cdot \left(\frac{0.0003}{0.21\text{mg/L}}\right) \cdot 0.9}{0.23\text{d}^{-1} \cdot (0.9 - 1)}\right)$$

14) Critical Time when we have Critical Oxygen Deficit

Open Calculator

$$t_c = \log 10\frac{\frac{D_c \cdot K_R}{K_D \cdot L_t}}{K_D}$$

ex

$$0.589551\text{d} = \log 10\frac{\frac{0.0003 \cdot 0.22\text{d}^{-1}}{0.23\text{d}^{-1} \cdot 0.21\text{mg/L}}}{0.23\text{d}^{-1}}$$

Deoxygenation Coefficient

15) Deoxygenation Coefficient given Self Purification Constant

Open Calculator

$$K_D = \frac{K_R}{f}$$

$$0.244444\text{d}^{-1} = \frac{0.22\text{d}^{-1}}{0.9}$$

16) Deoxygenation Constant given Self Purification Constant with Critical Oxygen Deficit

Open Calculator

$$K_D = \log 10\frac{D_c \cdot \frac{f}{L_t}}{t_c}$$

$$0.218289\text{d}^{-1} = \log 10\frac{0.0003 \cdot \frac{0.9}{0.21\text{mg/L}}}{0.5\text{d}}$$

Oxygen Deficit

17) DO Deficit using Streeter-Phelps Equation

Open Calculator

$$D = \left(K_D \cdot \frac{L}{K_R - K_D}\right) \cdot \left(10^{-K_D \cdot t} - 10^{-K_R \cdot t} + D_o \cdot 10^{-K_R \cdot t}\right)$$

$$5.364941\text{mg/L} = \left(0.23\text{d}^{-1} \cdot \frac{40\text{mg/L}}{0.22\text{d}^{-1} - 0.23\text{d}^{-1}}\right) \cdot \left(10^{-0.23\text{d}^{-1} \cdot 6\text{d}} - 10^{-0.22\text{d}^{-1} \cdot 6\text{d}} + 7.2\text{mg/L} \cdot 10^{-0.22\text{d}^{-1} \cdot 6\text{d}}\right)$$

18) Log value of Critical Oxygen Deficit

Open Calculator

$$D_c = 10^{\log 10\left(\frac{L_t}{f}\right) - (K_D \cdot t_c)}$$

$$0.000179 = 10^{\log 10\left(\frac{0.21\text{mg/L}}{0.9}\right) - (0.23\text{d}^{-1} \cdot 0.5\text{d})}$$

19) Oxygen Deficit

Open Calculator

$$D = S_{DO} - A_{DO}$$

$$4.2\text{mg/L} = 9\text{mg/L} - 4.8\text{mg/L}$$

20) Oxygen Deficit given Critical Time in Self Purification Factor

Open Calculator

$$D_c = \left(\frac{L_t}{f-1}\right)\cdot\left(1-\left(\frac{10^{t_c\cdot K_D\cdot(f-1)}}{f}\right)\right)$$

$$0.000172 = \left(\frac{0.21\text{mg/L}}{0.9-1}\right)\cdot\left(1-\left(\frac{10^{0.5\text{d}\cdot 0.23\text{d}^{-1}\cdot(0.9-1)}}{0.9}\right)\right)$$

Oxygen Equivalent

21) Oxygen Equivalent given Critical Oxygen Deficit

Open Calculator

$$L_t = D_c\cdot\frac{K_R}{K_D\cdot 10^{-K_D\cdot t_c}}$$

$$0.373952\text{mg/L} = 0.0003\cdot\frac{0.22\text{d}^{-1}}{0.23\text{d}^{-1}\cdot 10^{-0.23\text{d}^{-1}\cdot 0.5\text{d}}}$$

22) Oxygen Equivalent given Critical Time in Self Purification Factor

Open Calculator

$$L_t = D_c\cdot\frac{f-1}{1-\left(\frac{10^{t_c\cdot K_D\cdot(f-1)}}{f}\right)}$$

$$0.365518\text{mg/L} = 0.0003\cdot\frac{0.9-1}{1-\left(\frac{10^{0.5\text{d}\cdot 0.23\text{d}^{-1}\cdot(0.9-1)}}{0.9}\right)}$$

23) Oxygen Equivalent given Log value of Critical Oxygen Deficit

Open Calculator

$$L_t = f\cdot 10^{\log 10(D_c)+(K_D\cdot t_c)}$$

$$0.351855\text{mg/L} = 0.9\cdot 10^{\log 10(0.0003)+(0.23\text{d}^{-1}\cdot 0.5\text{d})}$$

24) Oxygen Equivalent given Self Purification Constant with Critical Oxygen Deficit

Open Calculator

$$L_t = D_c\cdot\frac{f}{10^{-K_D\cdot t_c}}$$

$$0.351855\text{mg/L} = 0.0003\cdot\frac{0.9}{10^{-0.23\text{d}^{-1}\cdot 0.5\text{d}}}$$

Reoxygenation Coefficient

25) Reoxygenation Coefficient at 20 Degree Celsius

Open Calculator

$$K_{R(20)} = \frac{K_R}{(1.016)^{T-20}}$$

$$0.22d^{-1} = \frac{0.22d^{-1}}{(1.016)^{20K-20}}$$

26) Reoxygenation Coefficient given Critical Oxygen Deficit

Open Calculator

$$K_R = K_D \cdot L_t \cdot \frac{10^{-K_D \cdot t_c}}{D_c}$$

$$0.123545d^{-1} = 0.23d^{-1} \cdot 0.21mg/L \cdot \frac{10^{-0.23d^{-1} \cdot 0.5d}}{0.0003}$$

27) Reoxygenation Coefficient given Self Purification Constant

Open Calculator

$$K_R = K_D \cdot f$$

$$0.207d^{-1} = 0.23d^{-1} \cdot 0.9$$

28) Reoxygenation Coefficients

Open Calculator

$$K_R = K_{R(20)} \cdot (1.016)^{T-20}$$

$$0.65d^{-1} = 0.65d^{-1} \cdot (1.016)^{20K-20}$$

29) Stream Depth given Reoxygenation Coefficient

Open Calculator

$$d = \left(3.9 \cdot \frac{\sqrt{v}}{k}\right)^{\frac{1}{1.5}}$$

$$42.25048m = \left(3.9 \cdot \frac{\sqrt{60m/s}}{0.11s^{-1}}\right)^{\frac{1}{1.5}}$$

30) Temperature given Reoxygenation Coefficient at T degree Celsius

Open Calculator

$$T = \log\left(\left(\frac{K_R}{K_{R(20)}}\right), 1.016\right) + 20$$

$$19.98535K = \log\left(\left(\frac{0.22d^{-1}}{0.65d^{-1}}\right), 1.016\right) + 20$$

Self Purification Constant

31) Self Purification Constant

Open Calculator

$$f = \frac{K_R}{K_D}$$

$$0.956522 = \frac{0.22d^{-1}}{0.23d^{-1}}$$

32) Self Purification Constant given Critical Oxygen Deficit

Open Calculator

$$f = L_t \cdot \frac{10^{-K_D \cdot t_c}}{D_c}$$

$$0.537153 = 0.21mg/L \cdot \frac{10^{-0.23d^{-1} \cdot 0.5d}}{0.0003}$$

33) Self Purification Constant given Log value of Critical Oxygen Deficit

Open Calculator

$$f = \frac{L_t}{10^{\log 10(D_c)+(K_D \cdot t_c)}}$$

$$0.537153 = \frac{0.21mg/L}{10^{\log 10(0.0003)+(0.23d^{-1} \cdot 0.5d)}}$$

Variables Used

- **A_{DO}** Actual Dissolved Oxygen *(Milligram per Liter)*
- **C** Mixing Concentration
- **C_R** River Concentration
- **C_s** Sewage Concentration
- **d** Depth of Stream *(Meter)*
- **D** Oxygen Deficit *(Milligram per Liter)*
- **D_c** Critical Oxygen Deficit
- **D_o** Initial Oxygen Deficit *(Milligram per Liter)*
- **f** Self-Purification Constant
- **k** Reoxygenation Coefficient per Sec *(1 Per Second)*
- **K_D** Deoxygenation Constant *(1 Per Day)*
- **K_R** Reoxygenation Coefficient *(1 Per Day)*
- **$K_{R(20)}$** Reoxygenation Coefficient at Temperature 20 *(1 Per Day)*
- **L** Organic Matter at Start *(Milligram per Liter)*
- **L_t** Oxygen Equivalent *(Milligram per Liter)*
- **Q_s** Sewage Discharge *(Cubic Meter per Second)*
- **Q_{stream}** Discharge in Stream *(Cubic Meter per Second)*
- **S_{DO}** Saturated Dissolved Oxygen *(Milligram per Liter)*
- **t** Time in Days *(Day)*
- **T** Temperature *(Kelvin)*
- **t_c** Critical Time *(Day)*
- **v** Velocity *(Meter per Second)*

Constants, Functions, Measurements used

- Function: **log**, log(Base, Number)
  Logarithmic function is an inverse function to exponentiation.
- Function: **log10**, log10(Number)
  The common logarithm, also known as the base-10 logarithm or the decimal logarithm, is a mathematical function that is the inverse of the exponential function.
- Function: **sqrt**, sqrt(Number)
  A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Time** in Day (d)
  Time Unit Conversion
- Measurement: **Temperature** in Kelvin (K)
  Temperature Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m^3/s)
  Volumetric Flow Rate Unit Conversion
- Measurement: **Density** in Milligram per Liter (mg/L)
  Density Unit Conversion
- Measurement: **First Order Reaction Rate Constant** in 1 Per Day (d^{-1}), 1 Per Second (s^{-1})
  First Order Reaction Rate Constant Unit Conversion

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- Design of a Chlorination System for Wastewater Disinfection Formulas
- Design of a Circular Settling Tank Formulas
- Design of a Plastic Media Trickling Filter Formulas
- Design of a Solid Bowl Centrifuge for Sludge Dewatering Formulas
- Design of an Aerated Grit Chamber Formulas
- Design of an Aerobic Digester Formulas
- Design of an Anaerobic Digester Formulas
- Design of Rapid Mix Basin and Flocculation Basin Formulas
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