Important Quality and Characteristics of Sewage Formulas PDF

Formulas
Examples
with Units

List of 33
Important Quality and Characteristics of Sewage Formulas

1) Time given Organic Matter Present at Start of BOD Formula

Evaluate Formula

Formula

$$t = -\left(\frac{1}{K_D}\right) \cdot \log10\left(\frac{L_t}{L_s}\right)$$

Example with Units

$$9.9124\,\text{d} = -\left(\frac{1}{0.23\,\text{d}^{-1}}\right) \cdot \log10\left(\frac{0.21\,\text{mg/L}}{40\,\text{mg/L}}\right)$$

2) Total Amount of Organic Matter Oxidised Formula

Evaluate Formula

Formula

$$l = L_s \cdot \left(1 - 10^{-K_D \cdot t}\right)$$

Example with Units

$$39.6595\,\text{mg/L} = 40\,\text{mg/L} \cdot \left(1 - 10^{-0.23\,\text{d}^{-1} \cdot 9\,\text{d}}\right)$$

3) Biodegradable Oxygen Demand BOD Formulas

3.1) BOD given Dilution Factor Formula

Evaluate Formula

Formula

$$BOD = DO \cdot \left(\frac{3}{4}\right)$$

Example with Units

$$9.375\,\text{mg/L} = 12.5\,\text{mg/L} \cdot \left(\frac{3}{4}\right)$$

3.2) BOD in Sewage Formula

Evaluate Formula

Formula

$$BOD = DO \cdot \left(\frac{V}{V_u}\right)$$

Example with Units

$$20.8333\,\text{mg/L} = 12.5\,\text{mg/L} \cdot \left(\frac{3.5\,\text{m}^3}{2.1\,\text{m}^3}\right)$$

3.3) BOD of Industry given Population Equivalent Formula

Evaluate Formula

Formula

$$Q = 0.08 \cdot P$$

Example with Units

$$120\,\text{mg/L} = 0.08 \cdot 1.5$$

4) Deoxygenation Constant Formulas

4.1) Deoxygenation Constant Formula

Evaluate Formula

Formula

$$K_D = \frac{K}{2.3}$$

Example with Units

$$0.3043\,d^{-1} = \frac{0.7\,d^{-1}}{2.3}$$

4.2) De-oxygenation Constant Formula

Evaluate Formula

Formula

$$K_D = 0.434 \cdot K$$

Example with Units

$$0.3038\,d^{-1} = 0.434 \cdot 0.7\,d^{-1}$$

4.3) Deoxygenation Constant at 20 degree Celsius Formula

Evaluate Formula

Formula

$$K_{D(20)} = \frac{K_{D(T)}}{1.047^{T-20}}$$

Example with Units

$$0.2374\,d^{-1} = \frac{0.15\,d^{-1}}{1.047^{10\,K - 20}}$$

4.4) Deoxygenation Constant at given Temperature Formula

Evaluate Formula

Formula

$$K_{D(T)} = K_{D(20)} \cdot (1.047)^{T-20}$$

Example with Units

$$0.1263\,d^{-1} = 0.20\,d^{-1} \cdot (1.047)^{10\,K - 20}$$

4.5) Deoxygenation Constant given Organic Matter Present at Start of BOD Formula

Evaluate Formula

Formula

$$K_D = -\left(\frac{1}{t}\right) \cdot \log 10\left(\frac{L_t}{L_s}\right)$$

Example with Units

$$0.2533\,d^{-1} = -\left(\frac{1}{9\,d}\right) \cdot \log 10\left(\frac{0.21\,mg/L}{40\,mg/L}\right)$$

4.6) Deoxygenation Constant given Total Amount of Organic Matter Oxidised Formula

Evaluate Formula

Formula

$$K_D = -\left(\frac{1}{t}\right) \cdot \log 10\left(1 - \left(\frac{Y_t}{L_s}\right)\right)$$

Example with Units

$$0.0442\,d^{-1} = -\left(\frac{1}{9\,d}\right) \cdot \log 10\left(1 - \left(\frac{24\,mg/L}{40\,mg/L}\right)\right)$$

5) DO Consumed Formulas

5.1) DO Consumed by Diluted Sample given BOD in Sewage Formula

Evaluate Formula

Formula

$$DO = \left(BOD \cdot \frac{V_u}{V}\right)$$

Example with Units

$$12\,mg/L = \left(20\,mg/L \cdot \frac{2.1\,m^3}{3.5\,m^3}\right)$$

6) Organic Matter Formulas

6.1) Organic Matter Present at Start of BOD Formula

Evaluate Formula

Formula	Example with Units
$L = \frac{L_t}{10^{-K_D \cdot t}}$	$24.6728\,\text{mg/L} = \frac{0.21\,\text{mg/L}}{10^{-0.23\,\text{d}^{-1} \cdot 9\,\text{d}}}$

6.2) Organic Matter Present at Start of BOD given Total Amount of Organic Matter Oxidised Formula

Evaluate Formula

Formula	Example with Units
$L = \frac{Y_t}{1 - 10^{-K_D \cdot t}}$	$24.206\,\text{mg/L} = \frac{24\,\text{mg/L}}{1 - 10^{-0.23\,\text{d}^{-1} \cdot 9\,\text{d}}}$

7) Oxygen Equivalent Formulas

7.1) Constant of Integration given Oxygen Equivalent Formula

Evaluate Formula

Formula	Example with Units
$c = \log\left(L_t, e\right) + \left(K \cdot t\right)$	$6.1819 = \log\left(0.21\,\text{mg/L}, e\right) + \left(0.7\,\text{d}^{-1} \cdot 9\,\text{d}\right)$

7.2) Oxygen Equivalent given Organic Matter Present at Start of BOD Formula

Evaluate Formula

Formula	Example with Units
$L_t = L_s \cdot 10^{-K_D \cdot t}$	$0.3405\,\text{mg/L} = 40\,\text{mg/L} \cdot 10^{-0.23\,\text{d}^{-1} \cdot 9\,\text{d}}$

8) PH of Sewage Formulas

8.1) pH value of Sewage Formula

Evaluate Formula

Formula	Example with Units
$pH = -\log 10\left(H^+\right)$	$-4.3979 = -\log 10\left(25\,\text{mol/L}\right)$

9) Population Equivalent Formulas

9.1) Population Equivalent Formula

Evaluate Formula

Formula	Example with Units
$P = \frac{Q}{0.08}$	$1.4625 = \frac{117\,\text{mg/L}}{0.08}$

9.2) Population Equivalent given standard BOD of Industrial Sewage Formula

Evaluate Formula

Formula	Example with Units
$P = \frac{Q}{D}$	$1.5 = \frac{117\,\text{mg/L}}{78\,\text{mg/L}}$

10) Rate Constant Formulas

10.1) Rate Constant given Deoxygenation Constant Formula

Evaluate Formula

Formula	Example with Units
$K = 2.3 \cdot K_D$	$0.529\,\mathrm{d^{-1}} = 2.3 \cdot 0.23\,\mathrm{d^{-1}}$

10.2) Rate Constant given De-oxygenation Constant Formula

Evaluate Formula

Formula	Example with Units
$K = \frac{K_D}{0.434}$	$0.53\,\mathrm{d^{-1}} = \frac{0.23\,\mathrm{d^{-1}}}{0.434}$

10.3) Rate Constant given Oxygen Equivalent Formula

Evaluate Formula

Formula	Example with Units
$K_h = \frac{c - \log(L_t, e)}{t}$	$9E\text{-}6\,\mathrm{Hz} = \frac{6.9 - \log(0.21\,\mathrm{mg/L}, e)}{9\,\mathrm{d}}$

11) Relative Stability Formulas

11.1) Period of Incubation given Relative Stability Formula

Evaluate Formula

Formula	Example with Units
$t = \frac{\ln\left(1 - \left(\frac{\%S}{100}\right)\right)}{\ln(0.794)}$	$16.9593\,\mathrm{d} = \frac{\ln\left(1 - \left(\frac{98}{100}\right)\right)}{\ln(0.794)}$

11.2) Period of Incubation given Relative Stability at 37 degree Celsius Formula

Evaluate Formula

Formula	Example with Units
$t = \frac{\ln\left(1 - \left(\frac{\%S}{100}\right)\right)}{\ln(0.630)}$	$8.4669\,\mathrm{d} = \frac{\ln\left(1 - \left(\frac{98}{100}\right)\right)}{\ln(0.630)}$

11.3) Relative Stability Formula

Evaluate Formula

Formula	Example with Units
$\%S = 100 \cdot \left(1 - (0.794)^{t}\right)$	$87.4575 = 100 \cdot \left(1 - (0.794)^{9\,\mathrm{d}}\right)$

11.4) Relative Stability at 37 Degree Celsius Formula

Evaluate Formula

Formula	Example with Units
$\%S = 100 \cdot \left(1 - (0.63)^{t}\right)$	$98.4366 = 100 \cdot \left(1 - (0.63)^{9\,\mathrm{d}}\right)$

12) Standard BOD Formulas

12.1) Standard BOD of Domestic Sewage given Standard BOD of Industrial Sewage Formula

Evaluate Formula

Formula	Example with Units
$D = \frac{Q}{P}$	$78\,\text{mg/L} = \frac{117\,\text{mg/L}}{1.5}$

12.2) Standard BOD of Industrial Sewage Formula

Evaluate Formula

Formula	Example with Units
$Q = D \cdot P$	$117\,\text{mg/L} = 78\,\text{mg/L} \cdot 1.5$

13) Threshold Odour Number Formulas

13.1) Threshold Odour Number Formula

Evaluate Formula

Formula	Example with Units
$T_o = V_s + \frac{V_D}{V_s}$	$12.4 = 2.2\,\text{m}^3 + \frac{22.44\,\text{m}^3}{2.2\,\text{m}^3}$

13.2) Volume of Distilled Water given Threshold Odour Number Formula

Evaluate Formula

Formula	Example with Units
$V_D = \left(T_o - 1\right) \cdot V_s$	$22.44\,\text{m}^3 = \left(11.2 - 1\right) \cdot 2.2\,\text{m}^3$

13.3) Volume of Sewage given Threshold Odour Number Formula

Evaluate Formula

Formula	Example with Units
$V_s = \frac{V_D}{T_o - 1}$	$2.2\,\text{m}^3 = \frac{22.44\,\text{m}^3}{11.2 - 1}$

14) Volume of Sample Formulas

14.1) Volume of Diluted Sample given BOD in Sewage Formula

Evaluate Formula

Formula	Example with Units
$V = BOD \cdot \frac{V_u}{DO}$	$3.36\,\text{m}^3 = 20\,\text{mg/L} \cdot \frac{2.1\,\text{m}^3}{12.5\,\text{mg/L}}$

14.2) Volume of Undiluted Sample given BOD in Sewage Formula

Evaluate Formula

Formula	Example with Units
$V_u = DO \cdot \frac{V}{BOD}$	$2.1875\,\text{m}^3 = 12.5\,\text{mg/L} \cdot \frac{3.5\,\text{m}^3}{20\,\text{mg/L}}$

Variables used in list of Quality and Characteristics of Sewage Formulas above

- **%S** Relative Stability
- **BOD** BOD *(Milligram per Liter)*
- **c** Integration Constant
- **D** BOD of Domestic Sewage *(Milligram per Liter)*
- **DO** DO Consumed *(Milligram per Liter)*
- H^+ Concentration of Hydrogen Ion *(Mole per Liter)*
- **K** Rate Constant in BOD *(1 Per Day)*
- K_D Deoxygenation Constant *(1 Per Day)*
- $K_{D(20)}$ Deoxygenation Constant at Temperature 20 *(1 Per Day)*
- $K_{D(T)}$ Deoxygenation Constant at Temperature T *(1 Per Day)*
- K_h Rate Constant *(Hertz)*
- **l** Organic Matter *(Milligram per Liter)*
- **L** Organic Matter at Start *(Milligram per Liter)*
- L_s Organic Matter at Start s *(Milligram per Liter)*
- L_t Oxygen Equivalent *(Milligram per Liter)*
- **P** Population Equivalent
- **pH** Negative Log of Hydronium Concentration
- **Q** BOD of Industrial Sewage *(Milligram per Liter)*
- **t** Time in Days *(Day)*
- **T** Temperature *(Kelvin)*
- T_o Threshold Odor Number
- **V** Volume of Diluted Sample *(Cubic Meter)*
- V_D Volume of Distilled Water *(Cubic Meter)*
- V_s Volume of Sewage *(Cubic Meter)*
- V_u Volume of Undiluted Sample *(Cubic Meter)*
- Y_t Organic Matter Oxidised *(Milligram per Liter)*

Constants, Functions, Measurements used in list of Quality and Characteristics of Sewage Formulas above

- constant(s): **e**, 2.71828182845904523536028747135266249
  Napier's constant
- Functions: **ln**, ln(Number)
  The natural logarithm, also known as the logarithm to the base e, is the inverse function of the natural exponential function.
- Functions: **log**, log(Base, Number)
  Logarithmic function is an inverse function to exponentiation.
- Functions: **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.
- Measurement: **Time** in Day (d)
  Time Unit Conversion
- Measurement: **Temperature** in Kelvin (K)
  Temperature Unit Conversion
- Measurement: **Volume** in Cubic Meter (m^3)
  Volume Unit Conversion
- Measurement: **Frequency** in Hertz (Hz)
  Frequency Unit Conversion
- Measurement: **Molar Concentration** in Mole per Liter (mol/L)
  Molar Concentration 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})
  First Order Reaction Rate Constant Unit Conversion

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