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Important Formulas in Mass Transfer Coefficient, Driving Force and Theories

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List of 29 Important Formulas in Mass Transfer Coefficient, Driving Force and Theories

Important Formulas in Mass Transfer Coefficient, Driving Force and Theories

1) Average Mass Transfer Coefficient by Penetration Theory

Open Calculator

fx $$k_{L\,(Avg)} = 2 \cdot \sqrt{\frac{D_{AB}}{\pi \cdot t_c}}$$

ex $$0.028465\text{m/s} = 2 \cdot \sqrt{\frac{0.007\text{m}^2/\text{s}}{\pi \cdot 11\text{s}}}$$

2) Average Sherwood Number of Combined Laminar and Turbulent Flow

Open Calculator

fx $$N_{sh} = \left(\left(0.037 \cdot \left(Re^{0.8}\right)\right) - 871\right) \cdot \left(Sc^{0.333}\right)$$

ex $$1074.78 = \left(\left(0.037 \cdot \left((500000)^{0.8}\right)\right) - 871\right) \cdot \left((12)^{0.333}\right)$$

3) Average Sherwood Number of Flat Plate Turbulent Flow

Open Calculator

fx $$N_{sh} = 0.037 \cdot \left(Re^{0.8}\right)$$

ex $$1340.842 = 0.037 \cdot \left((500000)^{0.8}\right)$$

4) Average Sherwood Number of Internal Turbulent Flow

Open Calculator

fx $$N_{sh} = 0.023 \cdot \left(Re^{0.83}\right) \cdot \left(Sc^{0.44}\right)$$

ex $$3687.336 = 0.023 \cdot \left((500000)^{0.83}\right) \cdot \left((12)^{0.44}\right)$$

5) Convective Mass Transfer Coefficient

Open Calculator

fx $$k_L = \frac{m_a}{\rho_{a1} - \rho_{a2}}$$

ex $$0.45\text{m/s} = \frac{9\text{kg/s/m}^2}{40\text{kg/m}^3 - 20\text{kg/m}^3}$$

6) Convective Mass Transfer Coefficient for Simultaneous Heat and Mass Transfer

Open Calculator

fx $$k_L = \frac{h_t}{Q_s \cdot \rho_L \cdot \left(L_e^{0.67}\right)}$$

ex $$4E\hat{}\text{-}5\text{m/s} = \frac{13.2\text{W/m}^2\text{*K}}{120\text{J/(kg*K)} \cdot 1000\text{kg/m}^3 \cdot \left((4.5)^{0.67}\right)}$$

7) Convective Mass Transfer Coefficient of Flat Plate in Combined Laminar Turbulent Flow

Open Calculator

fx $$k_L = \frac{0.0286 \cdot u_\infty}{\left(Re^{0.2}\right) \cdot \left(Sc^{0.67}\right)}$$

ex $$0.004118 \text{m/s} = \frac{0.0286 \cdot 10.5 \text{m/s}}{\left((500000)^{0.2}\right) \cdot \left((12)^{0.67}\right)}$$

8) Convective Mass Transfer Coefficient of Flat Plate Laminar Flow using Drag Coefficient

Open Calculator

fx $$k_L = \frac{C_D \cdot u_\infty}{2 \cdot \left(Sc^{0.67}\right)}$$

ex $$29.80088 \text{m/s} = \frac{30 \cdot 10.5 \text{m/s}}{2 \cdot \left((12)^{0.67}\right)}$$

9) Convective Mass Transfer Coefficient of Flat Plate Laminar Flow using Friction Factor

Open Calculator

fx $$k_L = \frac{f \cdot u_\infty}{8 \cdot \left(Sc^{0.67}\right)}$$

ex $$0.156455 \text{m/s} = \frac{0.63 \cdot 10.5 \text{m/s}}{8 \cdot \left((12)^{0.67}\right)}$$

10) Convective Mass Transfer Coefficient of Flat Plate Laminar Flow using Reynolds Number

Open Calculator

fx $$k_L = \frac{u_\infty \cdot 0.322}{\left(Re^{0.5}\right) \cdot \left(Sc^{0.67}\right)}$$

ex $$0.000905\text{m/s} = \frac{10.5\text{m/s} \cdot 0.322}{\left((500000)^{0.5}\right) \cdot \left((12)^{0.67}\right)}$$

11) Convective Mass Transfer Coefficient through Liquid Gas Interface

Open Calculator

fx $$k_L = \frac{m_1 \cdot m_2 \cdot H}{(m_1 \cdot H) + (m_2)}$$

ex $$0.004767\text{m/s} = \frac{0.3\text{m/s} \cdot 0.7\text{m/s} \cdot 0.016}{(0.3\text{m/s} \cdot 0.016) + (0.7\text{m/s})}$$

12) Fractional Resistance Offered by Gas Phase

Open Calculator

fx $$FR_g = \frac{\frac{1}{k_y}}{\frac{1}{K_y}}$$

ex $$0.84966 = \frac{\frac{1}{90\text{mol/s*m}^2}}{\frac{1}{76.46939\text{mol/s*m}^2}}$$

13) Fractional Resistance Offered by Liquid Phase

Open Calculator

fx $$FR_l = \frac{\frac{1}{k_x}}{\frac{1}{K_x}}$$

ex $$0.183673 = \frac{\frac{1}{9.2\text{mol/s*m}^2}}{\frac{1}{1.689796\text{mol/s*m}^2}}$$

14) Gas Phase Mass Transfer Coefficient by Two Film Theory

Open Calculator

fx $$K_y = \frac{1}{\left(\frac{1}{k_y}\right) + \left(\frac{H}{k_x}\right)}$$

ex $$77.81955\text{mol/s*m}^2 = \frac{1}{\left(\frac{1}{90\text{mol/s*m}^2}\right) + \left(\frac{0.016}{9.2\text{mol/s*m}^2}\right)}$$

15) Gas Phase Mass Transfer Coefficient using Fractional Resistance by Gas Phase

Open Calculator

fx $$k_y = \frac{K_y}{FR_g}$$

ex $$89.99999\text{mol/s*m}^2 = \frac{76.46939\text{mol/s*m}^2}{0.84966}$$

16) Heat Transfer Coefficient for Simultaneous Heat and Mass Transfer

Open Calculator

fx $$h_t = k_L \cdot \rho_L \cdot Q_s \cdot \left(L_e^{0.67}\right)$$

ex $$1479.266\text{W/m²*K} = 4.5\text{e-3m/s} \cdot 1000\text{kg/m³} \cdot 120\text{J/(kg*K)} \cdot \left((4.5)^{0.67}\right)$$

17) Liquid Phase Mass Transfer Coefficient by Two Film Theory

Open Calculator

fx $$K_x = \frac{1}{\left(\frac{1}{k_y \cdot H}\right) + \left(\frac{1}{k_x}\right)}$$

ex $$1.245113\text{mol/s*m²} = \frac{1}{\left(\frac{1}{90\text{mol/s*m²} \cdot 0.016}\right) + \left(\frac{1}{9.2\text{mol/s*m²}}\right)}$$

18) Liquid Phase Mass Transfer Coefficient using Fractional Resistance by Liquid Phase

Open Calculator

fx $$k_x = \frac{K_x}{FR_l}$$

ex $$9.200024\text{mol/s*m²} = \frac{1.689796\text{mol/s*m²}}{0.183673}$$

19) Local Sherwood Number for Flat Plate in Laminar Flow

Open Calculator

fx $$L_{sh} = 0.332 \cdot \left(Re_l^{0.5}\right) \cdot \left(Sc^{0.333}\right)$$

ex $$0.563231 = 0.332 \cdot \left((0.55)^{0.5}\right) \cdot \left((12)^{0.333}\right)$$

20) Local Sherwood Number for Flat Plate in Turbulent Flow

Open Calculator

$$L_{sh} = 0.0296 \cdot \left(Re_l^{0.8}\right) \cdot \left(Sc^{0.333}\right)$$

$$0.041971 = 0.0296 \cdot \left((0.55)^{0.8}\right) \cdot \left((12)^{0.333}\right)$$

21) Logarithmic Mean of Concentration Difference

Open Calculator

$$C_{bm} = \frac{C_{b2} - C_{b1}}{\ln\left(\frac{C_{b2}}{C_{b1}}\right)}$$

$$12.33152\text{mol/L} = \frac{10\text{mol/L} - 15\text{mol/L}}{\ln\left(\frac{10\text{mol/L}}{15\text{mol/L}}\right)}$$

22) Logarithmic Mean Partial Pressure Difference

Open Calculator

$$P_{bm} = \frac{P_{b2} - P_{b1}}{\ln\left(\frac{P_{b2}}{P_{b1}}\right)}$$

$$9571.809\text{Pa} = \frac{10500\text{Pa} - 8700\text{Pa}}{\ln\left(\frac{10500\text{Pa}}{8700\text{Pa}}\right)}$$

23) Mass Transfer Boundary Layer Thickness of Flat Plate in Laminar Flow

Open Calculator

$$\delta_{mx} = \delta_{hx} \cdot \left(Sc^{-0.333}\right)$$

$$3.715794 = 8.5\text{m} \cdot \left((12)^{-0.333}\right)$$

24) Mass Transfer Coefficient by Film Theory

Open Calculator

fx $$k_L = \frac{D_{AB}}{\delta}$$

ex $$1.4\text{m/s} = \frac{0.007\text{m}^2/\text{s}}{0.005\text{m}}$$

25) Mass Transfer Coefficient by Surface Renewal Theory

Open Calculator

fx $$k_L = \sqrt{D_{AB} \cdot s}$$

ex $$0.009165\text{m/s} = \sqrt{0.007\text{m}^2/\text{s} \cdot 0.012/\text{s}}$$

26) Mass Transfer Stanton Number

Open Calculator

fx $$St_m = \frac{k_L}{u_\infty}$$

ex $$0.000429 = \frac{4.5\text{e-}3\text{m/s}}{10.5\text{m/s}}$$

27) Overall Gas Phase Mass Transfer Coefficient using Fractional Resistance by Gas Phase

Open Calculator

fx $$K_y = k_y \cdot FR_g$$

ex $$76.4694\text{mol/s*m}^2 = 90\text{mol/s*m}^2 \cdot 0.84966$$

28) Overall Liquid Phase Mass Transfer Coefficient using Fractional Resistance by Liquid Phase

fx $$K_x = k_x \cdot FR_l$$

Open Calculator

ex $$1.689792\text{mol/s*m}^2 = 9.2\text{mol/s*m}^2 \cdot 0.183673$$

29) Sherwood Number for Flat Plate in Laminar Flow

fx $$N_{sh} = 0.664 \cdot \left(Re^{0.5}\right) \cdot \left(Sc^{0.333}\right)$$

Open Calculator

ex $$1074.04 = 0.664 \cdot \left((500000)^{0.5}\right) \cdot \left((12)^{0.333}\right)$$

Variables Used

- C_{b1} Concentration of Component B in Mixture 1 *(Mole per Liter)*
- C_{b2} Concentration of Component B in Mixture 2 *(Mole per Liter)*
- C_{bm} Logarithmic Mean of Concentration Difference *(Mole per Liter)*
- C_D Drag Coefficient
- D_{AB} Diffusion Coefficient (DAB) *(Square Meter Per Second)*
- **f** Friction Factor
- FR_g Fractional Resistance Offered by Gas Phase
- FR_l Fractional Resistance Offered by Liquid Phase
- **H** Henry's Constant
- h_t Heat Transfer Coefficient *(Watt per Square Meter per Kelvin)*
- $k_{L\ (Avg)}$ Average Convective Mass Transfer Coefficient *(Meter per Second)*
- k_L Convective Mass Transfer Coefficient *(Meter per Second)*
- k_L Convective Mass Transfer Coefficient *(Meter per Second)*
- k_x Liquid Phase Mass Transfer Coefficient *(Mole per Second Square Meter)*
- K_x Overall Liquid Phase Mass Transfer Coefficient *(Mole per Second Square Meter)*
- k_y Gas Phase Mass Transfer Coefficient *(Mole per Second Square Meter)*
- K_y Overall Gas Phase Mass Transfer Coefficient *(Mole per Second Square Meter)*
- L_e Lewis Number

- L_{sh} Local Sherwood Number
- m_1 Mass Transfer Coefficient of Medium 1 *(Meter per Second)*
- m_2 Mass Transfer Coefficient of Medium 2 *(Meter per Second)*
- m_a Mass Flux of Diffusion Component A *(Kilogram per Second per Square Meter)*
- N_{sh} Average Sherwood Number
- P_{b1} Partial Pressure of Component B in 1 *(Pascal)*
- P_{b2} Partial Pressure of Component B in 2 *(Pascal)*
- P_{bm} Logarithmic Mean Partial Pressure Difference *(Pascal)*
- Q_s Specific Heat *(Joule per Kilogram per K)*
- Re Reynolds Number
- Re_l Local Reynolds Number
- s Surface Renewal Rate *(1 Per Second)*
- Sc Schmidt Number
- St_m Mass Transfer Stanton Number
- t_c Average Contact Time *(Second)*
- u_∞ Free Stream Velocity *(Meter per Second)*
- δ Film Thickness *(Meter)*
- δ_{mx} Mass Transfer Boundary Layer Thickness at x
- ρ_{a1} Mass Concentration of Component A in Mixture 1 *(Kilogram per Cubic Meter)*
- ρ_{a2} Mass Concentration of Component A in Mixture 2 *(Kilogram per Cubic Meter)*
- ρ_L Density of Liquid *(Kilogram per Cubic Meter)*

- δ_{hx} Hydrodynamic Boundary Layer Thickness *(Meter)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **ln**, ln(Number)
  The natural logarithm, also known as the logarithm to the base e, is the inverse function of the natural 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 Second (s)
  Time Unit Conversion
- Measurement: **Pressure** in Pascal (Pa)
  Pressure Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Specific Heat Capacity** in Joule per Kilogram per K (J/(kg*K))
  Specific Heat Capacity Unit Conversion
- Measurement: **Heat Transfer Coefficient** in Watt per Square Meter per Kelvin (W/m²*K)
  Heat Transfer Coefficient Unit Conversion
- Measurement: **Molar Concentration** in Mole per Liter (mol/L)
  Molar Concentration Unit Conversion
- Measurement: **Mass Flux** in Kilogram per Second per Square Meter (kg/s/m²)

Mass Flux Unit Conversion

- Measurement: **Density** in Kilogram per Cubic Meter (kg/m³)
  Density Unit Conversion
- Measurement: **Diffusivity** in Square Meter Per Second (m²/s)
  Diffusivity Unit Conversion
- Measurement: **Molar Flux of Diffusing Component** in Mole per Second Square Meter (mol/s*m²)
  Molar Flux of Diffusing Component Unit Conversion
- Measurement: **Time Inverse** in 1 Per Second (1/s)
  Time Inverse Unit Conversion

Check other formula lists

- **Crystallization Formulas**
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- **Liquid Liquid Extraction Formulas**
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