



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

$$k_{
m L\,(Avg)} = 2 \cdot \sqrt{rac{{
m D}_{
m AB}}{\pi \cdot {
m t}_{
m c}}}$$

$$extbf{ex} 0.028465 ext{m/s} = 2 \cdot \sqrt{rac{0.007 ext{m}^2/ ext{s}}{\pi \cdot 11 ext{s}}}$$

2) Average Sherwood Number of Combined Laminar and Turbulent Flow

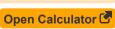
$$ext{Sh} = \left(\left(0.037\cdot\left(\mathrm{Re^{0.8}}
ight)
ight) - 871
ight)\cdot\left(\mathrm{Sc^{0.333}}
ight)$$

Open Calculator 🚰

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

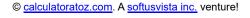
3) Average Sherwood Number of Flat Plate Turbulent Flow





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







4) Average Sherwood Number of Internal Turbulent Flow

 $ext{Sh} = 0.023 \cdot \left(ext{Re}^{0.83}
ight) \cdot \left(ext{Sc}^{0.44}
ight)$

Open Calculator 🗗

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

5) Convective Mass Transfer Coefficient

 $k_{
m L}=rac{m_{
m a}A}{
ho_{
m a1}ho_{
m a2}}$

Open Calculator

$$oxed{ex} 0.45 {
m m/s} = rac{9 {
m kg/s/m^2}}{40 {
m kg/m^3} - 20 {
m kg/m^3}}$$

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

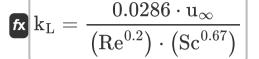
 $\mathbf{k}_{\mathrm{L}} = rac{\mathrm{h_{transfer}}}{\mathrm{c} \cdot \mathrm{
ho_{\mathrm{L}}} \cdot (\mathrm{L_{e}^{0.67}})}$

Open Calculator 🗗

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



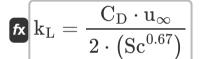
7) Convective Mass Transfer Coefficient of Flat Plate in Combined Laminar Turbulent Flow



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

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



Open Calculator

ex
$$29.80088 \mathrm{m/s} = rac{30 \cdot 10.5 \mathrm{m/s}}{2 \cdot \left(\left(12
ight)^{0.67}
ight)}$$

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

$$\mathbf{k}_{\mathrm{L}} = rac{\mathbf{f} \cdot \mathbf{u}_{\infty}}{8 \cdot (\mathrm{Sc}^{0.67})}$$

Open Calculator 🖸

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





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

 $\mathbf{k}_{\mathrm{L}} = rac{\mathrm{u}_{\infty} \cdot 0.322}{\left(\mathrm{Re}^{0.5}
ight) \cdot \left(\mathrm{Sc}^{0.67}
ight)}$

Open Calculator

 $ext{ex} 0.000905 ext{m/s} = rac{10.5 ext{m/s} \cdot 0.322}{\left((500000)^{0.5}
ight) \cdot \left((12)^{0.67}
ight)}$

11) Convective Mass Transfer Coefficient through Liquid Gas Interface

 $\mathbf{k}_{\mathrm{L}} = rac{\mathrm{m}_1 \cdot \mathrm{m}_2 \cdot \mathrm{H}}{(\mathrm{m}_1 \cdot \mathrm{H}) + (\mathrm{m}_2)}$

Open Calculator

 $= \frac{0.3 \text{m/s} \cdot 0.7 \text{m/s} \cdot 0.023}{(0.3 \text{m/s} \cdot 0.023) + (0.7 \text{m/s})}$

12) Fractional Resistance Offered by Gas Phase

 $\mathrm{FR}_{\mathrm{g}} = rac{rac{1}{\mathrm{k}_{\mathrm{y}}}}{rac{1}{\mathrm{K}_{\mathrm{y}}}}$

Open Calculator 🗗

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



13) Fractional Resistance Offered by Liquid Phase

 $ext{FR}_{
m l} = rac{rac{1}{
m k_x}}{rac{1}{
m K_x}}$

Open Calculator 🖸

ex $0.183673 = rac{rac{1}{9.2 ext{mol/s*m}^2}}{rac{1}{1.689796 ext{mol/s*m}^2}}$

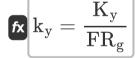
14) Gas Phase Mass Transfer Coefficient by Two Film Theory

 $\mathbf{K}_{\mathrm{y}} = rac{1}{\left(rac{1}{\mathrm{k}_{\mathrm{y}}}
ight) + \left(rac{\mathrm{H}}{\mathrm{k}_{\mathrm{x}}}
ight)}$

Open Calculator 🗗

 $73.46939 \text{mol/s*m}^2 = \frac{1}{\left(\frac{1}{90 \text{mol/s*m}^2}\right) + \left(\frac{0.023}{9.2 \text{mol/s*m}^2}\right)}$

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



Open Calculator 🗗

 $ext{ex} egin{array}{l} 89.999999000/s*m^2 & rac{76.469390000/s*m^2}{0.84966} \end{array}$



16) Heat Transfer Coefficient for Simultaneous Heat and Mass Transfer 🖸

 $\mathbf{h}_{\mathrm{transfer}} = \mathbf{k}_{\mathrm{L}} \cdot \mathbf{\rho}_{\mathrm{L}} \cdot \mathbf{c} \cdot \left(\mathbf{L}_{\mathrm{e}}^{0.67}\right)$

Open Calculator

ex

 $3122.894 \mathrm{W/m^2*K} = 9.5 \mathrm{e} ext{-}3 \mathrm{m/s} \cdot 1000 \mathrm{kg/m^3} \cdot 120 \mathrm{J/(kg*K)} \cdot \left({(4.5)}^{0.67}
ight)$

17) Liquid Phase Mass Transfer Coefficient by Two Film Theory

 $K_{x} = \frac{1}{\left(\frac{1}{k_{y} \cdot H}\right) + \left(\frac{1}{k_{y}}\right)}$

Open Calculator

ex $1.689796 \text{mol/s*m}^2 = \frac{1}{\left(\frac{1}{90 \text{mol/s*m}^2 \cdot 0.023}\right) + \left(\frac{1}{9.2 \text{mol/s*m}^2}\right)}$ 18) Liquid Phase Mass Transfer Coefficient using Fractional Resistance by

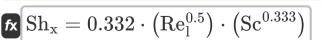
Liquid Phase

 $\mathbf{f}_{\mathbf{x}} \mathbf{k}_{\mathbf{x}} = rac{\mathbf{K}_{\mathbf{x}}}{\mathbf{F} \mathbf{R}_{\mathbf{x}}}$

Open Calculator

 $|9.200024 \text{mol/s*m}^2| = \frac{1.689796 \text{mol/s*m}^2}{0.100051}$ 0.183673

19) Local Sherwood Number for Flat Plate in Laminar Flow 🗗



Open Calculator

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



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20) Local Sherwood Number for Flat Plate in Turbulent Flow 🗗

Open Calculator $\mathrm{Sh_x} = 0.0296 \cdot (\mathrm{Re_1^{0.8}}) \cdot (\mathrm{Sc^{0.333}})$

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

21) Logarithmic Mean of Concentration Difference 🖸

 $m C_{bm} = rac{C_{b2} - C_{b1}}{ln \left(rac{C_{b2}}{C_{b1}}
ight)}$

 $ext{ex} 12.33152 ext{mol/L} = rac{10 ext{mol/L} - 15 ext{mol/L}}{ ext{ln} \left(rac{10 ext{mol/L}}{15 ext{mol/L}}
ight)}$

22) Logarithmic Mean Partial Pressure Difference 🛂

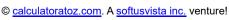
 $ho_{\mathrm{bm}} = rac{\mathrm{P}_{\mathrm{b2}} - \mathrm{P}_{\mathrm{b1}}}{\ln\left(rac{\mathrm{P}_{\mathrm{b2}}}{\mathrm{P}_{\mathrm{b1}}}
ight)}$

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

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

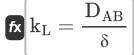
 $\mathbf{ex} \ 3.715794 = 8.5 \mathrm{m} \cdot \left((12)^{-0.333} \right)$







24) Mass Transfer Coefficient by Film Theory 🚰



Open Calculator

 $m ex = rac{0.007 m^2/s}{0.005 m}$

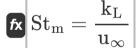
25) Mass Transfer Coefficient by Surface Renewal Theory



Open Calculator 🖸

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

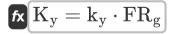
26) Mass Transfer Stanton Number 🗲



Open Calculator

 $0.000905 = rac{9.5 ext{e-} 3 ext{m/s}}{10.5 ext{m/s}}$

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







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

 $K_x = k_x \cdot FR_1$

Open Calculator G

Open Calculator

 $(2.689792 \text{mol/s*m}^2 = 9.2 \text{mol/s*m}^2 \cdot 0.183673)$

29) Sherwood Number for Flat Plate in Laminar Flow 🗗



 $m{ ext{ex}} \left[1074.04 = 0.664 \cdot \left((500000)^{0.5}
ight) \cdot \left((12)^{0.333}
ight)$

 $\mathrm{Sh} = 0.664 \cdot \left(\mathrm{Re}^{0.5} \right) \cdot \left(\mathrm{Sc}^{0.333} \right)$





Variables Used

- **C** Specific Heat (Joule per Kilogram per K)
- C_{b1} Concentration of Component B in Mixture 1 (Mole per Liter)
- Ch2 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_{α} Fractional Resistance Offered by Gas Phase
- FRI Fractional Resistance Offered by Liquid Phase
- H Henry's Constant
- htransfer 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_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**_v Gas Phase Mass Transfer Coefficient (Mole per Second Square Meter)
- K_y Overall Gas Phase Mass Transfer Coefficient (Mole per Second Square Meter)
- Le Lewis Number





- m₁ Mass Transfer Coefficient of Medium 1 (Meter per Second)
- m₂ Mass Transfer Coefficient of Medium 2 (Meter per Second)
- m_aA Mass Flux of Diffusion Component A (Kilogram per Second per Square Meter)
- P_{b1} Partial Pressure of Component B in Mixture 1 (Pascal)
- Ph2 Partial Pressure of Component B in Mixture 2 (Pascal)
- P_{bm} Logarithmic Mean Partial Pressure Difference (Pascal)
- Re Reynolds Number
- Re_I Local Reynolds Number
- S Surface Renewal Rate (1 Per Second)
- Sc Schmidt Number
- Sh Average Sherwood Number
- Sh_x Local Sherwood 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)
- PI Density of Liquid (Kilogram per Cubic Meter)
- $\delta_{ extsf{hx}}$ Hydrodynamic Boundary Layer Thickness (Meter)





Constants, Functions, Measurements used

- Constant: pi, 3.14159265358979323846264338327950288
 Archimedes' constant
- Function: In, In(Number)

 Natural logarithm function (base e)
- Function: sqrt, sqrt(Number)
 Square root function
- 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

- Gas Absorption & Stripping Formulas
- Important Formulas in Mass Transfer Coefficient, Driving Force and Theories
- Liquid-Liquid Extraction Formulas
- Mass Transfer Coefficient Formulas
- Mass Transfer Theories Formulas

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