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Condensation Formulas

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List of 22 Condensation Formulas

Condensation

1) Average Heat Transfer Coefficient for Condensation Inside Horizontal Tubes for Low Vapor Velocity

Open Calculator

fx $$h^{-} = 0.555 \cdot \left(\frac{\rho_f \cdot (\rho_f - \rho_v) \cdot [g] \cdot h'_{fg} \cdot \left(k_f^3\right)}{L \cdot D_{Tube} \cdot (T_{Sat} - T_w)} \right)^{0.25}$$

ex $$14.42554 W/m^2*K = 0.555 \cdot \left(\frac{96 kg/m^3 \cdot (96 kg/m^3 - 0.5 kg/m^3) \cdot [g] \cdot 3100000 J/kg \cdot \left((0.67 W/(m*K))^3\right)}{65 m \cdot 9.71 m \cdot (373 K - 82 K)} \right)^{0.}$$

2) Average Heat Transfer Coefficient for Film Condensation on Plate for Wavy Laminar Flow

Open Calculator

fx $$h^{-} = 1.13 \cdot \left(\frac{\rho_f \cdot (\rho_f - \rho_v) \cdot [g] \cdot h_{fg} \cdot \left(k_f^3\right)}{L \cdot \mu_f \cdot (T_{Sat} - T_w)} \right)^{0.25}$$

ex $$116.0939 W/m^2*K = 1.13 \cdot \left(\frac{96 kg/m^3 \cdot (96 kg/m^3 - 0.5 kg/m^3) \cdot [g] \cdot 2260000 J/kg \cdot \left((0.67 W/(m*K))^3\right)}{65 m \cdot 0.029 N*s/m^2 \cdot (373 K - 82 K)} \right)^{0.2}$$

3) Average Heat Transfer Coefficient for Laminar Film Condensation of Tube

Open Calculator

fx $$h^{-} = 0.725 \cdot \left(\frac{\rho_f \cdot (\rho_f - \rho_v) \cdot [g] \cdot h_{fg} \cdot \left(k_f^3\right)}{D_{Tube} \cdot \mu_f \cdot (T_{Sat} - T_w)} \right)^{0.25}$$

ex $$119.8098 W/m^2*K = 0.725 \cdot \left(\frac{96 kg/m^3 \cdot (96 kg/m^3 - 0.5 kg/m^3) \cdot [g] \cdot 2260000 J/kg \cdot \left((0.67 W/(m*K))^3\right)}{9.71 m \cdot 0.029 N*s/m^2 \cdot (373 K - 82 K)} \right)^{0.}$$

4) Average Heat Transfer Coefficient for Laminar Film Condensation on Outside of Sphere

Open Calculator

fx $$h^{-} = 0.815 \cdot \left(\frac{\rho_f \cdot (\rho_f - \rho_v) \cdot [g] \cdot h_{fg} \cdot \left(k_f^3\right)}{D_{Sphere} \cdot \mu_f \cdot (T_{Sat} - T_w)} \right)^{0.25}$$

ex $$134.6481 W/m^2*K = 0.815 \cdot \left(\frac{96 kg/m^3 \cdot (96 kg/m^3 - 0.5 kg/m^3) \cdot [g] \cdot 2260000 J/kg \cdot \left((0.67 W/(m*K))^3\right)}{9.72 m \cdot 0.029 N*s/m^2 \cdot (373 K - 82 K)} \right)^{0.}$$

5) Average Heat Transfer Coefficient for Vapor Condensing on Plate

Open Calculator

fx $$h^{-} = 0.943 \cdot \left(\frac{\rho_f \cdot (\rho_f - \rho_v) \cdot [g] \cdot h_{fg} \cdot \left(k_f^3\right)}{L \cdot \mu_f \cdot (T_{Sat} - T_w)} \right)^{0.25}$$

ex $$96.8819 W/m^2*K = 0.943 \cdot \left(\frac{96 kg/m^3 \cdot (96 kg/m^3 - 0.5 kg/m^3) \cdot [g] \cdot 2260000 J/kg \cdot \left((0.67 W/(m*K))^3\right)}{65 m \cdot 0.029 N*s/m^2 \cdot (373 K - 82 K)} \right)^{0.2}$$

6) Average Heat Transfer Coefficient given Reynolds Number and Properties at Film Temperature

Open Calculator

fx $$h^{-} = \frac{0.026 \cdot \left(P_f^{\frac{1}{3}}\right) \cdot \left(Re_m^{0.8}\right) \cdot (K_f)}{D_{Tube}}$$

ex $$0.782819 W/m^2*K = \frac{0.026 \cdot \left((0.95)^{\frac{1}{3}}\right) \cdot \left((2000)^{0.8}\right) \cdot (0.68 W/(m*K))}{9.71 m}$$

7) Condensation Number

Open Calculator

fx $$Co = (h^{-}) \cdot \left(\left(\frac{(\mu_f)^2}{\left(k^3\right) \cdot (\rho_f) \cdot (\rho_f - \rho_v) \cdot [g]} \right)^{\frac{1}{3}} \right)$$

ex $$0.023802 = (115 W/m^2*K) \cdot \left(\left(\frac{(0.029 N*s/m^2)^2}{\left((10.18 W/(m*K))^3\right) \cdot (96 kg/m^3) \cdot (96 kg/m^3 - 0.5 kg/m^3) \cdot [g]} \right)^{\frac{1}{3}} \right)$$

8) Condensation Number for Horizontal Cylinder

Open Calculator

$$\text{Co} = 1.514 \cdot \left((\text{Re}_\text{f})^{-\frac{1}{3}} \right)$$

$$0.226162 = 1.514 \cdot \left((300)^{-\frac{1}{3}} \right)$$

9) Condensation Number for Vertical Plate

Open Calculator

$$\text{Co} = 1.47 \cdot \left((\text{Re}_\text{f})^{-\frac{1}{3}} \right)$$

$$0.219589 = 1.47 \cdot \left((300)^{-\frac{1}{3}} \right)$$

10) Condensation Number given Reynolds Number

Open Calculator

$$\text{Co} = \left((\text{C})^{\frac{4}{3}} \right) \cdot \left(\left(\frac{4 \cdot \sin(\Phi) \cdot \left(\left(\frac{\text{A}_\text{cs}}{\text{P}} \right) \right)}{\text{L}} \right)^{\frac{1}{3}} \right) \cdot \left((\text{Re}_\text{f})^{-\frac{1}{3}} \right)$$

$$0.139312 = \left((1.5)^{\frac{4}{3}} \right) \cdot \left(\left(\frac{4 \cdot \sin(1.55\text{rad}) \cdot \left(\left(\frac{25\text{m}^2}{9.6\text{m}} \right) \right)}{65\text{m}} \right)^{\frac{1}{3}} \right) \cdot \left((300)^{-\frac{1}{3}} \right)$$

11) Condensation Number when Turbulence is Encountered in Film

Open Calculator

$$\text{Co} = 0.0077 \cdot \left((\text{Re}_\text{f})^{0.4} \right)$$

$$0.075394 = 0.0077 \cdot \left((300)^{0.4} \right)$$

12) Film Thickness given Mass Flow of Condensate

Open Calculator

$$\delta = \left(\frac{3 \cdot \mu_\text{f} \cdot \dot{\text{m}}}{\rho_\text{L} \cdot (\rho_\text{L} - \rho_\text{v}) \cdot [\text{g}]} \right)^{\frac{1}{3}}$$

$$0.002316\text{m} = \left(\frac{3 \cdot 0.029\text{N*s/m}^2 \cdot 1.40\text{kg/s}}{1000\text{kg/m}^3 \cdot (1000\text{kg/m}^3 - 0.5\text{kg/m}^3) \cdot [\text{g}]} \right)^{\frac{1}{3}}$$

13) Film Thickness in Film Condensation

Open Calculator

$$\delta = \left(\frac{4 \cdot \mu_f \cdot k \cdot x \cdot (T_{Sat} - T_w)}{[g] \cdot h_{fg} \cdot (\rho_L) \cdot (\rho_L - \rho_v)} \right)^{0.25}$$

$$0.000982\text{m} = \left(\frac{4 \cdot 0.029\text{N*s/m}^2 \cdot 10.18\text{W/(m*K)} \cdot 0.06\text{m} \cdot (373\text{K} - 82\text{K})}{[g] \cdot 2260000\text{J/kg} \cdot (1000\text{kg/m}^3) \cdot (1000\text{kg/m}^3 - 0.5\text{kg/m}^3)} \right)^{0.25}$$

14) Heat Transfer Coefficient for Condensation on Flat Plate for Nonlinear Temperature Profile in Film

Open Calculator

$$h'_{fg} = (h_{fg} + 0.68 \cdot c \cdot (T_{Sat} - T_w))$$

$$3.1\text{E}\hat{}6\text{J/kg} = (2260000\text{J/kg} + 0.68 \cdot 4184\text{J/(kg*K)} \cdot (373\text{K} - 82\text{K}))$$

15) Heat Transfer Rate for Condensation of Superheated Vapors

Open Calculator

$$q = \bar{h} \cdot A_{plate} \cdot ((T_s') - T_w)$$

$$28658\text{W} = 115\text{W/m}^2\text{*K} \cdot 35.6\text{m}^2 \cdot (89\text{K} - 82\text{K})$$

16) Mass Flow of Condensate through any X Position of Film

Open Calculator

$$\dot{m} = \frac{\rho_L \cdot (\rho_L - \rho_v) \cdot [g] \cdot \left(\delta^3\right)}{3 \cdot \mu_f}$$

$$1.406851\text{kg/s} = \frac{1000\text{kg/m}^3 \cdot (1000\text{kg/m}^3 - 0.5\text{kg/m}^3) \cdot [g] \cdot \left((0.00232\text{m})^3\right)}{3 \cdot 0.029\text{N*s/m}^2}$$

17) Mass Flow Rate through Particular Section of Condensate Film given Reynolds Number of Film

Open Calculator

$$\dot{m}_1 = \frac{Re_f \cdot P \cdot \mu}{4}$$

$$7200\text{kg/s} = \frac{300 \cdot 9.6\text{m} \cdot 10\text{N*s/m}^2}{4}$$

18) Reynolds Number for Condensate Film

Open Calculator

$$Re_f = \frac{4 \cdot \dot{m}_1}{P \cdot \mu}$$

$$300 = \frac{4 \cdot 7200\text{kg/s}}{9.6\text{m} \cdot 10\text{N*s/m}^2}$$

19) Reynolds Number using Average Heat Transfer Coefficient for Condensate Film

Open Calculator

$$\mathrm{Re_f} = \left(\frac{4 \cdot \bar{h} \cdot L \cdot (T_{Sat} - T_w)}{h_{fg} \cdot \mu_f}\right)$$

$$132.7571 = \left(\frac{4 \cdot 115\mathrm{W/m^2*K} \cdot 65\mathrm{m} \cdot (373\mathrm{K} - 82\mathrm{K})}{2260000\mathrm{J/kg} \cdot 0.029\mathrm{N*s/m^2}}\right)$$

20) Viscosity of Film given Mass Flow of Condensate

Open Calculator

$$\mu_f = \frac{\rho_L \cdot (\rho_L - \rho_v) \cdot [g] \cdot \left(\delta^3\right)}{3 \cdot \dot{m}}$$

$$0.029142\mathrm{N*s/m^2} = \frac{1000\mathrm{kg/m^3} \cdot (1000\mathrm{kg/m^3} - 0.5\mathrm{kg/m^3}) \cdot [g] \cdot \left((0.00232\mathrm{m})^3\right)}{3 \cdot 1.40\mathrm{kg/s}}$$

21) Viscosity of Film given Reynolds Number of Film

Open Calculator

$$\mu_f = \frac{4 \cdot \dot{m}_1}{P \cdot \mathrm{Re_f}}$$

$$10\mathrm{N*s/m^2} = \frac{4 \cdot 7200\mathrm{kg/s}}{9.6\mathrm{m} \cdot 300}$$

22) Wetted Perimeter given Reynolds Number of Film

Open Calculator

$$P = \frac{4 \cdot \dot{m}_1}{\mathrm{Re_f} \cdot \mu}$$

$$9.6\mathrm{m} = \frac{4 \cdot 7200\mathrm{kg/s}}{300 \cdot 10\mathrm{N*s/m^2}}$$

Variables Used

- A_{cs} Cross Sectional Area of Flow *(Square Meter)*
- A_{plate} Area of Plate *(Square Meter)*
- **c** Specific Heat Capacity *(Joule per Kilogram per K)*
- **C** Constant for Condensation Number
- **Co** Condensation Number
- D_{Sphere} Diameter of Sphere *(Meter)*
- D_{Tube} Diameter of Tube *(Meter)*
- $\bar{h}$ Average Heat Transfer Coefficient *(Watt per Square Meter per Kelvin)*
- h_{fg} Latent Heat of Vaporization *(Joule per Kilogram)*
- h'_{fg} Corrected Latent Heat of Vaporization *(Joule per Kilogram)*
- **k** Thermal Conductivity *(Watt per Meter per K)*
- k_f Thermal Conductivity of Film Condensate *(Watt per Meter per K)*
- K_f Thermal Conductivity at Film Temperature *(Watt per Meter per K)*
- **L** Length of Plate *(Meter)*
- $\dot{m}$ Mass Flow Rate *(Kilogram per Second)*
- $\dot{m}_1$ Mass Flow of Condensate *(Kilogram per Second)*
- **P** Wetted Perimeter *(Meter)*
- P_f Prandtl Number at Film Temperature
- **q** Heat Transfer *(Watt)*
- Re_f Reynolds Number of Film
- Re_m Reynolds Number for Mixing
- T_s' Saturation Temperature for Superheated Vapor *(Kelvin)*
- T_{Sat} Saturation Temperature *(Kelvin)*
- T_w Plate Surface Temperature *(Kelvin)*
- **x** Height of Film *(Meter)*
- **δ** Film Thickness *(Meter)*
- **μ** Viscosity of Fluid *(Newton Second per Square Meter)*
- μ_f Viscosity of Film *(Newton Second per Square Meter)*
- ρ_f Density of Liquid Film *(Kilogram per Cubic Meter)*
- ρ_L Density of Liquid *(Kilogram per Cubic Meter)*
- ρ_v Density of Vapor *(Kilogram per Cubic Meter)*
- **Φ** Inclination Angle *(Radian)*

Constants, Functions, Measurements used

- Constant: **[g]**, 9.80665 Meter/Second²
  Gravitational acceleration on Earth
- Function: **sin**, sin(Angle)
  Trigonometric sine function
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Temperature** in Kelvin (K)
  Temperature Unit Conversion
- Measurement: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Power** in Watt (W)
  Power Unit Conversion
- Measurement: **Angle** in Radian (rad)
  Angle Unit Conversion
- Measurement: **Thermal Conductivity** in Watt per Meter per K (W/(m*K))
  Thermal Conductivity Unit Conversion
- Measurement: **Specific Heat Capacity** in Joule per Kilogram per K (J/(kg*K))
  Specific Heat Capacity Unit Conversion
- Measurement: **Mass Flow Rate** in Kilogram per Second (kg/s)
  Mass Flow Rate Unit Conversion
- Measurement: **Heat Transfer Coefficient** in Watt per Square Meter per Kelvin (W/m²*K)
  Heat Transfer Coefficient Unit Conversion
- Measurement: **Dynamic Viscosity** in Newton Second per Square Meter (N*s/m²)
  Dynamic Viscosity Unit Conversion
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m³)
  Density Unit Conversion
- Measurement: **Latent Heat** in Joule per Kilogram (J/kg)
  Latent Heat Unit Conversion

Check other formula lists

- Boiling Formulas
- Condensation Formulas
- Important Formulas of Condensation Number, Average Heat Transfer Coefficient and Heat Flux

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