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Basic Formulas of Mechanical Operations

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List of 21 Basic Formulas of Mechanical Operations

Basic Formulas of Mechanical Operations

1) Applied Pressure in Terms of Coefficient of Flowability for Solids

Open Calculator

fx $$P_A = \frac{P_N}{K}$$

ex $$8.9982\text{Pa} = \frac{15\text{Pa}}{1.667}$$

2) Coefficient of Flowability of Solids

Open Calculator

fx $$K = \frac{P_N}{P_A}$$

ex $$1.666667 = \frac{15\text{Pa}}{9\text{Pa}}$$

3) Energy Required to Crush Coarse Materials according to Bond's Law

Open Calculator

fx $$E = W_i \cdot \left(\left(\frac{100}{d_2} \right)^{0.5} - \left(\frac{100}{d_1} \right)^{0.5} \right)$$

ex $$22.15064\text{J/kg} = 11.6\text{J/kg} \cdot \left(\left(\frac{100}{1.9\text{m}} \right)^{0.5} - \left(\frac{100}{3.5\text{m}} \right)^{0.5} \right)$$

4) Fraction of Cycle Time used for Cake Formation

Open Calculator

fx $$f = \frac{t}{t_c}$$

ex $$0.2 = \frac{0.8s}{4s}$$

5) Mass Mean Diameter

Open Calculator

fx $$D_W = (x_A \cdot D_{pi})$$

ex $$3m = (0.6 \cdot 5m)$$

6) Material Characteristic using Angle of Friction

Open Calculator

fx $$K_M = \frac{1 - \sin(\Phi)}{1 + \sin(\Phi)}$$

ex $$0.42173 = \frac{1 - \sin(24^\circ)}{1 + \sin(24^\circ)}$$

7) Number of Particles

Open Calculator

fx $$N_p = \frac{m}{\rho_{particle} \cdot V_{particle}}$$

ex $$2.04918 = \frac{0.15kg}{12.2kg/m^3 \cdot 0.006m^3}$$

8) Porosity or Void Fraction

Open Calculator

$$\varepsilon = \frac{v_0}{v_B}$$

$$0.066667 = \frac{0.02\text{m}^3}{0.3\text{m}^3}$$

9) Pressure Gradient using Kozeny Carman Equation

Open Calculator

$$\text{dPbydr} = \frac{150 \cdot \mu \cdot (1-\eta)^2 \cdot v}{(\Phi_p)^2 \cdot (\text{De})^2 \cdot (\eta)^3}$$

$$10.30234\text{N/m}^3 = \frac{150 \cdot 0.59\text{P} \cdot (1-0.5)^2 \cdot 60\text{m/s}}{(18.46)^2 \cdot (0.55\text{m})^2 \cdot (0.5)^3}$$

10) Projected Area of Solid Body

Open Calculator

$$A_p = 2 \cdot \frac{F_D}{C_D \cdot \rho_l \cdot (v_{liquid})^2}$$

$$0.064667\text{m}^2 = 2 \cdot \frac{80\text{N}}{1.98 \cdot 3.9\text{kg/m}^3 \cdot (17.9\text{m/s})^2}$$

11) Sauter Mean Diameter

Open Calculator

$$d_{sauter} = \frac{6 \cdot V_{particle\_1}}{S_{particle}}$$

$$8.942308\text{m} = \frac{6 \cdot 15.5\text{m}^3}{10.4\text{m}^2}$$

12) Specific Surface Area of Mixture

Open Calculator

$$A_w = \frac{SA_{Total}}{M_T}$$

$$3.706294\text{m}\hat{}2/\text{kg} = \frac{53\text{m}^2}{14.3\text{kg}}$$

13) Sphericity of Cuboidal Particle

Open Calculator

$$\Phi_{cuboidalparticle} = \frac{\left(\left((L \cdot b \cdot h) \cdot \left(\frac{0.75}{\pi}\right)\right)^{\frac{1}{3}} \hat{} \ 2\right) \cdot 4 \cdot \pi}{2 \cdot (L \cdot b + b \cdot h + h \cdot L)}$$

$$0.130583 = \frac{\left(\left((3\text{m} \cdot 2\text{m} \cdot 12\text{m}) \cdot \left(\frac{0.75}{\pi}\right)\right)^{\frac{1}{3}} \hat{} \ 2\right) \cdot 4 \cdot \pi}{2 \cdot (3\text{m} \cdot 2\text{m} + 2\text{m} \cdot 12\text{m} + 12\text{m} \cdot 3\text{m})}$$

14) Sphericity of Cylindrical Particle

Open Calculator

$$\Phi_{cylindricalparticle} = \frac{\left(\left(\left((R)^2 \cdot H \cdot \frac{3}{4}\right)^{\frac{1}{3}}\right)^2\right) \cdot 4 \cdot \pi}{2 \cdot \pi \cdot R \cdot (R + H)}$$

ex $$0.820941 = \frac{\left(\left(\left((0.025\text{m})^2 \cdot 0.11\text{m} \cdot \frac{3}{4}\right)^{\frac{1}{3}}\right)^2\right) \cdot 4 \cdot \pi}{2 \cdot \pi \cdot 0.025\text{m} \cdot (0.025\text{m} + 0.11\text{m})}$$

15) Sphericity of Particle

Open Calculator

$$\Phi_p = \frac{6 \cdot V_s}{S_{particle} \cdot De}$$

ex $$18.46154 = \frac{6 \cdot 17.6\text{m}^3}{10.4\text{m}^2 \cdot 0.55\text{m}}$$

16) Surface Shape Factor

Open Calculator

$$\Phi_s = \frac{1}{\Phi_p}$$

ex $$0.054171 = \frac{1}{18.46}$$

17) Terminal Settling Velocity of Single Particle

Open Calculator

fx $$V_t = \frac{V}{(\in)^n}$$

ex $$0.198886\text{m/s} = \frac{0.1\text{m/s}}{(0.75)^{2.39}}$$

18) Time Required for Cake Formation

Open Calculator

fx $$t = f \cdot t_c$$

ex $$0.8\text{s} = 0.2 \cdot 4\text{s}$$

19) Total Number of Particles in Mixture

Open Calculator

fx $$N_T = \frac{M_T}{\rho_p \cdot V_p}$$

ex $$143 = \frac{14.3\text{kg}}{100\text{kg/m}^3 \cdot .001\text{m}^3}$$

20) Total Surface Area of Particle using Spericity

Open Calculator

fx $$A_{sa} = M \cdot \frac{6}{\Phi_p \cdot \rho_p \cdot d_p}$$

ex $$0.01629\text{m}^2 = 50.12\text{kg} \cdot \frac{6}{18.46 \cdot 100\text{kg/m}^3 \cdot 10\text{m}}$$

21) Total Surface Area of Particles

Open Calculator

fx $$\mathrm{SA} = \mathrm{S} \cdot \mathrm{N_p}$$

ex $$22.032\mathrm{m^2} = 10.8\mathrm{m^2} \cdot 2.04$$

Variables Used

- $\in$ Void fraction
- A_p Projected Area of Solid Particle Body *(Square Meter)*
- A_{sa} Total Surface Area of Particles *(Square Meter)*
- A_w Specific Surface Area of Mixture *(Square Meter per Kilogram)*
- **b** Breadth *(Meter)*
- C_D Drag Coefficient
- d_1 Feed Diameter *(Meter)*
- d_2 Product Diameter *(Meter)*
- d_p Arithmetic Mean Diameter *(Meter)*
- D_{pi} Size Of Particles Present In Fraction *(Meter)*
- d_{sauter} Sauter Mean Diameter *(Meter)*
- D_W Mass Mean Diameter *(Meter)*
- **De** Equivalent Diameter *(Meter)*
- **dPbydr** Pressure Gradient *(Newton per Cubic Meter)*
- **E** Energy per Unit Mass of Feed *(Joule per Kilogram)*
- **f** Fraction of Cycle Time Used For Cake Formation
- F_D Drag Force *(Newton)*
- **h** Height *(Meter)*
- **H** Cylinder Height *(Meter)*
- **K** Coefficient of Flowability
- K_M Material Characteristic
- **L** Length *(Meter)*

- **m** Mixture Mass *(Kilogram)*
- **M** Mass *(Kilogram)*
- M_T Total Mass of Mixture *(Kilogram)*
- **n** Richardsonb Zaki Index
- N_p Number of Particles
- N_T Total Number of Particles in Mixture
- P_A Applied Pressure *(Pascal)*
- P_N Normal Pressure *(Pascal)*
- **R** Cylinder Radius *(Meter)*
- **S** Surface Area of One Particle *(Square Meter)*
- $S_{particle}$ Surface Area of Particle *(Square Meter)*
- **SA** Surface Area *(Square Meter)*
- SA_{Total} Total Surface Area *(Square Meter)*
- **t** Time Required For Cake Formation *(Second)*
- t_c Total Cycle Time *(Second)*
- **v** Velocity *(Meter per Second)*
- **V** Settling Velocity of Group of Particles *(Meter per Second)*
- v_0 Volume of Voids in Bed *(Cubic Meter)*
- v_B Total Volume of Bed *(Cubic Meter)*
- v_{liquid} Velocity of Liquid *(Meter per Second)*
- V_p Volume Of One Particle *(Cubic Meter)*
- $V_{particle}$ Volume of Spherical Particle *(Cubic Meter)*
- $V_{particle\_1}$ Volume of Particle *(Cubic Meter)*
- V_s Volume of One Spherical Particle *(Cubic Meter)*

- V_t Terminal Velocity of Single Particle *(Meter per Second)*
- W_i Work Index *(Joule per Kilogram)*
- x_A Mass Fraction
- ε Porosity or Void Fraction
- η Porosity
- μ Dynamic Viscosity *(Poise)*
- ρ_l Density of Liquid *(Kilogram per Cubic Meter)*
- ρ_p Density Of Particle *(Kilogram per Cubic Meter)*
- $\rho_{particle}$ Density of One Particle *(Kilogram per Cubic Meter)*
- Φ Angle of Friction *(Degree)*
- $\Phi_{cuboidalparticle}$ Sphericity of Cuboidal Particle
- $\Phi_{cylindricalparticle}$ Sphericity of Cylindrical Particle
- Φ_p Sphericity of Particle
- Φ_s Surface Shape Factor

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **sin**, sin(Angle)
  Trigonometric sine function
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Weight** in Kilogram (kg)
  Weight Unit Conversion
- Measurement: **Time** in Second (s)
  Time Unit Conversion
- Measurement: **Volume** in Cubic Meter (m^3)
  Volume Unit Conversion
- Measurement: **Area** in Square Meter (m^2)
  Area Unit Conversion
- Measurement: **Pressure** in Pascal (Pa)
  Pressure Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle Unit Conversion
- Measurement: **Dynamic Viscosity** in Poise (P)
  Dynamic Viscosity Unit Conversion
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m^3)
  Density Unit Conversion

- Measurement: **Specific Energy** in Joule per Kilogram (J/kg)
  Specific Energy Unit Conversion
- Measurement: **Pressure Gradient** in Newton per Cubic Meter (N/m³)
  Pressure Gradient Unit Conversion
- Measurement: **Specific Area** in Square Meter per Kilogram (m^2/kg)
  Specific Area Unit Conversion

Check other formula lists

- **Basic Formulas**
- **Basic Formulas of Mechanical Operations**

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