Lecture 3: Exercise on measurement of quantities.

Content

Exercise (i) Specific gravity of slurry

Exercise (ii) % solids in slurry

Exercise (iii)Mixing of slurry streams

Exercise (iv)Slurry making

Exercise (v)Units

Exercise (vi)Quiz question

Exercise – (I) specific gravity of slurry

Calculate specific gravity of slurry which contains 65% lime. The specific gravity of lime is 2600 kg/m^3. Also calculate volume of slurry.

Substituting the values in equation 1of lecture 2

$$65 = \frac{100\times 2600(\rho_m - 100)}{\rho_m(2600-1000)}$$

By solving ρ_m = specific gravity of slurry $= 1667\ \frac{kg}{m^3}$

Volume of slurry in percent $= 65 \times \frac{1667}{2600} = 41.66\%$

Exercise – (II): % solids in slurry

A slurry stream containing quartz is diverted into a 1 liter can. Time taken to fill is 8 seconds. The density of the slurry and quartz is 1400 kg/m^3 and 2600 kg/m^3 respectively. Calculate (a) percent solids by weight and (b) mass flow rate quartz within slurry.

Substituting the values in equation 1 of lecture 2

$$\%\ \text{solid}\ (\%x) = \frac{100\times\rho_s(\rho_m-1000)}{\rho_{m\,(\rho_s-1000)}}$$

$$= \frac{100\times 2650\times 400}{1400\times 1600}$$

=45.88%.

Equation 3 of lecture 2

$$M(kg/hr) = \frac{F\rho_s(\rho_m-1000)}{(\rho_s-1000)}$$

$\mathrm{F} = \frac{3600}{8000}\ \mathrm{m}^3/\mathrm{hr}.$

$\mathrm{M} = \frac{3600}{8000} \times 1400 \times 0.4588$

=289kg/hr.

If the time to fill the can is 7s,rest everything remains the same, calculate mass flow rate of quartz in slurry.

Answer =330 kg/hr

Exercise (III) Mixing of slurry streams

Two slurry streams enter a pump. One stream has flow rate of 5m^3/hr and contains 40% solids by weight. Other stream has 3.4 m^3/hr flow rate and contains 55% solids by weight. Density of solid is 3000kg m^{-3} in both slurry streams. Calculate tonnage of any solids pumped/hr.

To solve the problem, use the following steps.

1. Calculate density of slurry streams $\rho_{\mathrm{M1}} = 1364\,\mathrm{kg/m^3}$ and $1579\ \frac{\mathrm{kg}}{\mathrm{m^3}}$
2. Calculate mass flow rate of slurry $\mathrm{M}_1 = 2728$ and $\mathrm{M}_2 = 2953\ \mathrm{kg/hr}$
3. Add mass flow rate which will give 5.681T/hr.

Exercise (IV) Slurry making

Calculate how many kg of magnetite must be added to 100kg water to make up a slurry with specific gravity $(\rho_{\mathrm{m}}) = 1.4.\,\mathrm{g/cm^3}$.

Specific gravity of $\mathrm{Fe_3O4} = 5.2\mathrm{g/cm^3}$

Wt % solid =$\frac{100\times5.2\ (1.4-1)}{1.4\times(5.2-1)} = \frac{100\times5.2\times0.4}{1.4\times4.2} = 35.4\ \%.$

Wt % water =100 – 35.4=64.6 %

$\frac{\text{total mass}}{\text{massof water}} = \frac{\mathrm{M_m}}{\mathrm{M_{H_2O}}} = \frac{100\%}{64.6\%}$

$\mathrm{M_m} = \frac{100\%}{64.6\%} \times 100$

=155kg

Mass of magnetite =155-100 =55kg

Exercise (V) Units

a) Convert 360 mm Hg pressure into (a)N/m^2 and (b)Lb/ft^2

   Answer = 47995.2 N/m^2 and 1002.4 Lb/ft^2

b) Calculate the value of universal gas constant into (a)CGS unit and (b)MKS unit . given $\mathrm{R} = 82.0578 \ \frac{\mathrm{Cm}^3 \ \mathrm{atim}}{\mathrm{gmole} \ ^\circ\mathrm{C}}$. The problem is solved in lecture 2.

c) Pressure in an evacuated vessel was recorded 1.2dynes/Cm^2. Express this value in microns of mercury at $25^\circ\mathrm{C}$.
   Answer 1.596 micron.

Exercise (VI) Quiz question

Two streams of slurry enter a pump. The volumetric flow rate of stream2 is 0.68 times and density is 1.16 times that of slurry no. 1 respectively. if density of slurry no.1is 1364 kg/m^3 . Then mass flow rate (M_1) of slurry stream no.1is

(A) $\mathrm{M}_1 = 0.72 \ \mathrm{M}_2$ (B) $\mathrm{M}_1 = 0.92 \ \mathrm{M}_2$ (C) $\mathrm{M}_1 = 1.5 \ \mathrm{M}_2$

(D) $\mathrm{M}_1 = 0.8 \ \mathrm{M}_2$

M_2 is mass flow rate of slurry 2

One can derive the following equation expressing mass flow rates in terms volume flow rates and density of slurry

$$\frac{\mathrm{M}_1}{\mathrm{M}_2} = \frac{\mathrm{F}_1}{\mathrm{F}_2} \ \frac{(\rho_{\mathrm{M}1} - 1000)}{(\rho_{\mathrm{M}2})}$$

M_1 and M_2 mass flow rate of stream 1 and 2

F_1 and F_2 volume flow rate of stream 1 and 2

$\rho_{\mathrm{M}1}$ and $\rho_{\mathrm{M}2}$ density of slummy 1 and 2.

Using above equation: $\mathrm{F}_2 = 0.68 \ \mathrm{F}_1 \text{and } \rho_{\mathrm{M}2} = 1.16 \ \rho_{\mathrm{M}1}$.

$\mathrm{M}_1 = 0.92 \ \mathrm{M}_2$ 'B' is correct.