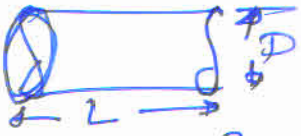
Pneumatic Transport



Net force $= \frac{1}{2} \rho_g \bar{U}_{g,\text{super}}^2 A\epsilon + \frac{1}{2} \rho_p \bar{U}_{p,\text{super}}^2 A(1-\epsilon)$

$(\Delta P_{net})A - F_{g,\omega} - F_{P,g,\text{single particl.}} \times n - \text{gravity force (for both gas \& solid)}$

d_p = particle diameter

$f_{g,\omega} \rightarrow Re_{g,\omega} = \frac{\rho_g \bar{U}_{g,\text{super}} D}{\mu_g}$

$F_{g\omega} = (\Delta P_{g,\omega}) A\epsilon$

$= \frac{1}{2} f_{g\omega} \rho_g \bar{U}_{g,\text{super}}^2 \frac{L}{D} A\epsilon$

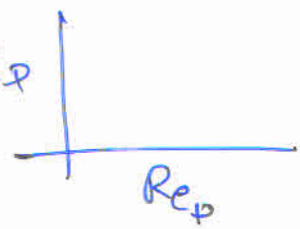
$= \left(\frac{1}{2} f_{g\omega} \bar{U}_{g,\text{super}}^2 \frac{L}{D} A\right)(\rho\epsilon)$

also known as dispersed gas density ρ_{gd}.

$F_{g,P,\text{single particl.}}$

$= \frac{1}{2} C_D \rho_g (\bar{U}_{g,\text{super}} - \bar{U}_{P,\text{super}})^2 \frac{\pi d_p^2}{4}$

Re_p



$Re_p = \frac{\rho_g (|\bar{U}_{g,\text{super}} - \bar{U}_{p,\text{super}}|) d_p}{\mu_g}$

n = no of particles

$= \frac{A(1-\epsilon)}{\frac{4}{3}\pi d_p^3}$

Slurry Transport

Homogeneous :-

If constitutive equation is not known, in that case one has to use Moody chart for knowing f (friction factor), which needs Re calculation.

$$Re = \frac{\rho_b U_s D}{\mu_l}$$

ρ_b = bulk density of slurry.

if feed composition is a : b by mass%. (liquid : solid)

$$\rho_b = \frac{a+b}{\frac{a}{\rho_l} + \frac{b}{\rho_s}}$$

U_s = slurry superficial velocity

$$= \frac{\dot{m}_{\text{total of slurry}}}{A}$$

μ_l = liquid density

(although one should take μ of slurry, however many times we approximate it with viscosity of carrying liquid)

Hetrogeneous

$$\frac{(\Delta P)_{\text{slurry}}}{(\Delta P)_{\text{carrying liquid}}} = f(\ ,\ , C_D)$$

$\Delta P_{\text{carrying liquid}}$ needs f

slurry superficial velocity → need Re for liquid only.

$$Re_l = \frac{\rho_l U_s D}{\mu_l}$$

U_s = slurry superficial velocity (means if liquid will flow with U_s, what will be Re)

C_D is particle level calculation

$Re_{\text{particle}} = Re_p$ → C_D | Re_p

$$Re_p = \frac{\rho_l U_s d_p}{\mu_l}$$ (d_p → particle diameter)