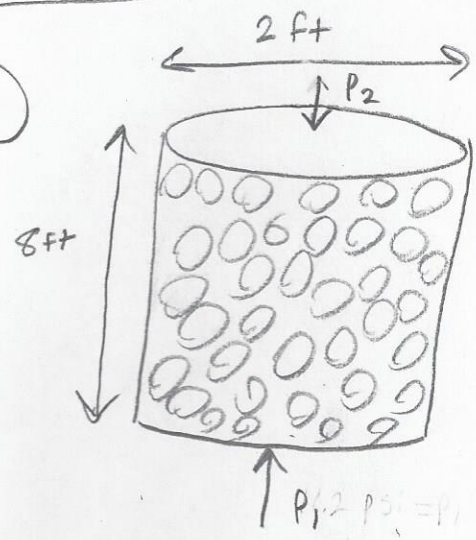
HW 4

$\rho_{air} = \frac{RT}{}$

$\rho = \frac{PM}{RT}$

① 

$T = 100°F$ $\quad \phi_s = 1.0$ $\quad L_b = 8\ ft$

$D_p = 0.5''$

$\varepsilon = 0.38$

$\dot{m} = 47.5\ lbm/min$

$\Delta P = ?$

$P_1 = 16.2\ psia$

$\rho_{air} = ?$

$u_o = Q/A =$

$\dot{m} = \rho Q$

$Q = \dot{m}/\rho$

$u_o = \frac{\dot{m}/\rho}{A}$

$\mu = 4.02 \times 10^{-7} \frac{slug}{ft \cdot s} \times \frac{32.2\ lbm}{slug} = 1.29 \times 10^{-5} \frac{lbm}{ft \cdot s}$

Ergun Equation: $\Delta P = \frac{150\, u_o \mu L_b}{D_p^2} \cdot \frac{(1-\varepsilon)^2}{\varepsilon^3} + \frac{1.75\, \rho u_o^2 L_b}{D_p} \cdot \frac{(1-\varepsilon)}{\varepsilon^3}$

$47.5 \frac{lbm}{min} \times \frac{1\ min}{60\ s} = .792\ lbm/s$

$\rho = \frac{\left(16.2 \frac{lbf}{in^2} \times 144 \frac{in^2}{ft^2}\right)\left(29 \frac{lbm}{lbmol}\right)}{\left(1545.3 \frac{ft\ lbf}{°R \cdot lbmol}\right)(100°F)} = .438 \frac{lbm}{ft^3}$

$u_o = \frac{.792\ lbm/s}{\frac{.438\ lbm}{ft^3} \cdot \frac{\pi (2\ ft)^2}{4}} = .576\ ft/s$

$\Delta P = \frac{150 (.576\ ft/s)\left(1.29 \times 10^{-5} \frac{lbm}{ft \cdot s}\right)(8\ ft)}{\left(\frac{0.5}{12}\ ft\right)^2} \cdot \frac{(1-0.38)^2}{.38^3}$

$+ \frac{1.75 \left(.438 \frac{lbm}{ft^3}\right)(.576\ ft/s)^2 (8\ ft)}{\left(\frac{0.5}{12}\ ft\right)} \cdot \frac{(1-0.38)}{.38^3}$

$\Delta P = 553.2 \frac{lbf}{ft^2} \times \frac{1\ ft^2}{144\ in^2}$

$\boxed{\Delta P = 3.84\ psi}$