



$$r' = k' P_A^{1/3} P_B^{1/3} \quad \frac{\text{lbmol}}{\text{lb}_{\text{cat}} \cdot \text{hr}} \quad k = 0.0141 \frac{\text{lbmol}}{\text{atm} \cdot \text{lb}_{\text{m}} \cdot \text{hr}}$$



$$F_{A0} = 1.08 \frac{\text{lb-mol}}{\text{hr}} \quad F_{C0} = 0 \frac{\text{lbmol}}{\text{hr}}$$

$$F_{B0} = 0.54 \frac{\text{lbmol}}{\text{hr}} \quad F_{I0} = F_{B0} \cdot \frac{0.79}{0.21}$$

$$\frac{dF_A}{dW} = -r'$$

$$\frac{dF_C}{dW} = r'$$

$$P_i = \frac{F_i}{F_T} P_T = \frac{F_i}{F} P_0$$

$$\frac{dF_B}{dW} = -\frac{1}{2} r'$$

$$F_i = F_A + F_B + F_C + F_{I0}$$

Pressure drop $\rightarrow \frac{dP}{dz} \neq 0$ or $\frac{dP}{dW} \neq 0$

Ergun equation

Pressure

u - superficial velocity

gas viscosity

$$\frac{dP}{dz} = - \frac{G}{P g_c D_p} \left(\frac{1-\phi}{\phi^3} \right) \left[\underbrace{\frac{150(1-\phi)\mu}{D_p}}_{\text{laminar}} + \underbrace{1.75G}_{\text{turbulent}} \right]$$

length

gas density

Pressure dependent

particle diameter

Porosity

32.174 lb_m · ft / s² · lb_f

At steady state

$$\dot{m}_0 = \dot{m}$$

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$$v = v_0 \frac{P_0}{P} \frac{T}{T_0} \frac{F_T}{F_{T0}}$$

$$P_0 v_0 = P v \Rightarrow P = P_0 \frac{v_0}{v}$$

$$\hookrightarrow \boxed{P = P_0 \frac{P}{P_0} \frac{T_0}{T} \frac{F_{T0}}{F_T}}$$

$$\frac{dP}{dz} = - \frac{G(1-\phi)}{P_0 g_c D_p \phi^3} \left[\frac{150(1-\phi)\mu}{D_p} + 1.75G \right] \frac{P_0}{P} \frac{T}{T_0} \frac{F_T}{F_{T0}}$$

catalyst density

$$\text{let } W = (1-\phi)A_c \cdot z \cdot \rho_c$$

$$\beta_0 = \frac{G(1-\phi)}{P_0 g_c \cancel{D_p} \phi^3} \left[\frac{150(1-\phi)\mu}{D_p} + 1.75G \right]$$

$$\frac{dP}{dW} = - \frac{\beta_0}{A_c(1-\phi)\rho_c} \frac{P_0}{P} \frac{T}{T_0} \frac{F_T}{F_{T0}}$$

$$\text{let } \alpha = \frac{2\beta_0}{A_c \rho_c (1-\phi)P_0}$$

$$\boxed{\frac{dP}{dW} = - \frac{\alpha}{2} \frac{P_0}{P/P_0} \frac{F_T}{F_{T0}}}$$