

$$\xi_{DP} = 2Pe^{2/3} + 1.24 \left(\frac{d_p}{d_f} \right)^{2/3} (KaPe)^{-1/2}, \quad Pe = \frac{d_f U_0}{D_p} = \frac{3\pi d_f U_0 \eta d_p}{kT C_c}$$

Gravitational Settling

$$\xi_{GS} = G_f \left(1 + \frac{d_p}{d_f} \right) \sin \alpha, \quad G_f = \frac{V_{TS}}{U_0} = \frac{\rho_p d_p^2 C_c \delta}{18\eta U_0}$$

Electrostatic Deposition

$$\xi_{ED} = 1.5 \left(\frac{\epsilon_f - 1}{\epsilon_f + 1} \right) \frac{d_p^2}{12\pi^2 \eta U_0 \epsilon_0 d_f d_p^2} \right)^{1/2}, \quad \epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{N}\cdot\text{m}^2$$

Total Single-Fiber Collection Efficiency

$$\xi_{TS} = 1 - (1 - \xi_{DP})(1 - \xi_{GS})(1 - \xi_{ED})(1 - \xi_{IE})(1 - \xi_{FE})$$

$$\text{Penetration } P_a = 1 - \eta_f = \exp \left(-\eta_{TS} \frac{4\pi\epsilon_0 H_f}{\pi d_f} \right)$$

$$\text{Pressure Drop } \Delta P = \frac{64\eta H_f U_0 d_f^3 (1 + 56\alpha d_f^3)}{d_f^2}, \quad (\text{for } 0.006 < \alpha < 0.3)$$

$$\xi_D = 2Pe^{-\frac{2}{3}} + 1.24 \left(\frac{d_p}{d_f} \right)^{\frac{3}{2}} (K\mu Pe)^{-\frac{1}{2}}, \quad Pe = \frac{d_f U_0}{D_p} = \frac{3\pi d_f U_0 \eta d_p}{kT C_c}$$

Gravitational Settling

$$\xi_D = G_f \left(1 + \frac{d_p}{d_f} \right) \sin \alpha, \quad G_f = \frac{V_{\text{set}}}{U_0} = \frac{\rho_p d_p^2 C_c \mathcal{L}}{18\eta U_0}$$

Electrostatic Deposition

$$\xi_D = 1.5 \left(\frac{(e_f - 1)}{(e_f + 1)} \frac{d^2}{12\pi^2 \eta U_0 \epsilon_0 d_p d_f^2} \right)^{\frac{1}{2}}$$

$$\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{N}\cdot\text{m}^2$$

Total Single-Fiber Collection Efficiency

$$\xi_{Tf} = 1 - (1 - \xi_{Df})(1 - \xi_{If})(1 - \xi_{Rf})(1 - \xi_{Jf})(1 - \xi_{E})$$

$$\text{Penetration} \quad P_n = 1 - \eta_f = \exp \left(-\eta_{Tf} \frac{4\pi \mathcal{L}}{\pi d_f} H_f \right)$$

$$\text{Pressure Drop} \quad \Delta P = \frac{64\eta H_f U_0 d_f^{2.5} (1 + 56\alpha_f^2)}{d_f^2}, \quad (\text{for } 0.006 < \alpha_f < 0.3)$$