1-4 [2]

$D = 2\,m$

$m_s = 2000\,kg/h$ $\quad w_s = 0{,}10\ kg/kg$

$w_k = 0{,}50\ kg/kg$

$d_p = ?$ $\quad \varrho_s = 2500\,kg/m^3$

$\varrho = 1000\,kg/m^3$

$\eta = 10^{-3}\ Pa\cdot s$

$$v_u = \frac{\dot V_F}{S}$$

$$\dot m_s = \dot m_k + \dot m_F \qquad \dot m_s w_s = \dot m_k w_k$$

$$\dot m_s = \frac{w_s}{w_k}\dot m_s + \dot m_F$$

$$S = \pi d^2/4$$

$$\dot m_F = \left(1 - \frac{w_s}{w_k}\right)\dot m_s = \left(1 - \frac{0{,}1}{0{,}5}\right)2000 = 1600\,kg/h$$

$$\dot V_F = \dot m_F/\varrho = 1600/1000 = 1{,}6\,m^3/h$$

$$= 4{,}444\cdot 10^{-4}\,m^3/s$$

$$v_u = \frac{1{,}6/3600\cdot 4}{\pi\cdot 2^2}$$

$$v_u = 1{,}415\cdot 10^{-4}\ m/s \qquad v_u \geq 1{,}415\cdot 10^{-4}\ m/s$$

$$L_y = \frac{v_u^3\,\varrho}{g\cdot\eta}\cdot\frac{\varrho}{\Delta\varrho} = \frac{(1{,}415\cdot 10^{-4})^3\cdot 1000^2}{9{,}81\cdot 10^{-3}\,(2500-1000)} = 1{,}925\cdot 10^{-7}$$

$$Re_u = \sqrt{18\,L_y} = 0{,}001862$$

$$d_p = Re_u\cdot\eta/(v_u\varrho) = \frac{0{,}001862\cdot 1\cdot 10^{-3}}{1{,}415\cdot 10^{-4}\cdot 1000} = 1{,}32\cdot 10^{-5} = 13{,}2\cdot 10^{-6}\,m$$