

一、选择题

1. c

2. c

3. c

4. b

5. c

二、填空题

1. 增大, 不变

2. 0.333

3. 改进塔顶液体原始喷淋的均匀性, 多设喷淋点; 在填料层中设置液体再分布器;
控制塔径与填料尺寸的比值

$$4. y = \left(\frac{\frac{y_A}{x_A}}{\frac{y_B}{x_B}} \right), 7.309$$

5. 热空气, 载热体, 载湿体

三、思考题

$$(1) \text{ 斯托克斯区: } Re_p < 2, u_t = \frac{gd_p^2(\rho_s - \rho)}{18\mu}$$

若处于此区域, 降尘室的含尘气体温度升高, 气体黏度增加, 颗粒沉降速度减小, 相同情况下大部分颗粒未达到降尘室底部而被带出降尘室, 因次降尘室出口气体含量增加。

$$(2) \text{ 牛顿区: } Re_p = (500 - 2 \times 10^5), u_t = 1.74 \sqrt{\frac{gd_p(\rho_s - \rho)}{\rho}}$$

若处于此区域, 降尘室的含尘气体温度升高, 气体黏度增加, 颗粒沉降速度不受影响, 因次降尘室出口气体含尘量不变。

1. (1) 选取原料罐液面为 1-1'，密封高位槽液面为 2-2' 则

$$z_1 = 0, z_2 = 8; P_1(\text{绝压}) \text{未知}, l + le = 16.7 \text{ m}$$

$$P_1(\text{绝压}) = P_1(\text{表压}) + P_0 = 1.215 \times 10^5 + \frac{1.013 \times 10^5}{760} \times 755 = 222133.5526 \text{ Pa}$$

$$u_0 = u_1 = 0, d = 0.032 \text{ m}, \sum \zeta = 0.5 + 1 + 1.18 = 2.68, u = \frac{4V}{\pi d^2} = 15.55 \text{ m/s}$$

$$\sum H_f = \left(\lambda \frac{l+le}{d} + \sum \zeta \right) \frac{u^2}{2g} = 197.68 \text{ J/N}$$

(2) 在 1-2 截面列伯努利方程

$$z_1 + \frac{P_1}{\rho g} + \frac{u_1^2}{2g} = z_2 + \frac{P_2}{\rho g} + \frac{u_2^2}{2g} + \sum H_f, \text{代入数据得: } P_1 = 2.454 \times 10^6 \text{ Pa}$$

2. 在河水和高位槽水面列伯努利方程得管路特性曲线:

$$H = H_0 + \frac{8\lambda(l+le)}{\pi^2 g d^5} V^2 = 12 + 1211582 V^2 (V: \text{m}^3/\text{s}, H: \text{m})$$

泵特性曲线单位换算

$$H = 50 - 720000 V^2 (V: \text{m}^3/\text{s}, H: \text{m})$$

$$\text{联立两方程解得: } V = 4.435 \times 10^{-3} \text{ m}^3/\text{s} = 15.98 \text{ m}^3/\text{h}, H = 35.83 \text{ m}$$

$$N_e = \rho g V H_e = 1558.87 \text{ W}$$

(2) 设流量改变后转速为 n_2 , 此时泵特性方程为:

$$H = 50 \left(\frac{n_2}{1500} \right)^2 - 720000 V^2, \text{再与管路特性方程联立, 已知 } V_2 = 1.2V = 5.322 \times 10^{-3} \text{ m}^3/\text{s}$$

$$\text{解得: } n_2 = 1733 \text{ r/min}$$

3. (1) 板框式压滤机最大生产能力满足条件:

$$\tau_R = \tau_W + \tau_F, \tau_W = 8J\tau_F, \text{联立解得 } \tau_F = 16.67 \text{ min}, \tau_W = 13.33 \text{ min}$$

$$\text{过滤基本方程: } V^2 = KA^2\tau \Rightarrow V^2 = 9.375 \times 10^{-3} \tau$$

$$\text{当 } \tau_F = 16.67 \text{ min} = 1000.2 \text{ s}, V_F = 3.062 \text{ m}^3$$

$$G = \frac{V_F}{\tau_R + \tau_W + \tau_F} = \frac{V_F}{2\tau_R} = 3.062 \text{ m}^3/\text{h}$$

(2) 辅助时间不变, 则生产能力与 V_F 成正比

$$\frac{G'}{G} = \frac{V_F'}{V_F} = \sqrt{\frac{K'}{K}} = \sqrt{\frac{\Delta P_m'}{\Delta P_m}} = \sqrt{\frac{9.81 \times 10^4}{1.47 \times 10^5}} = 0.817$$

4. (1) 由于管壁及污垢热阻可忽略, 则

$$\frac{1}{K} = \frac{1}{\alpha_h} + \frac{1}{\alpha_c} \Rightarrow K = 230.177 \text{ W}/(\text{m}^2 \cdot ^\circ\text{C})$$

(2) 联立串联传热公式:

$$Q = W_c C_{pc} (t_2 - t_1) = W_h C_{ph} (T_1 - T_2) = K_o A_o \Delta T_m$$

其中 $\Delta T_m = \frac{\Delta T_1 - \Delta T_2}{\ln \frac{\Delta T_1}{\Delta T_2}} = 29.72^\circ\text{C}$, $A_o = \pi d_o L$, 代入解得 $L = 6.017 \text{ m}$

(3) 由题(2)得: $W_c = \frac{W_h C_{ph} (T_1 - T_2)}{C_{pc} (t_2 - t_1)} = 500.897 \text{ kg/h}$

5. 由题意操作压力加倍后, H_{OG} 变, N_{OG} 变

已知 $x_2 = 0, y_1 = 0.06$, 由 $\eta = \frac{y_1 - y_2}{y_1}$ 得, $y_2 = 0.0012$

$$\frac{1}{A} = \frac{mG}{L} = m \frac{x_1}{y_1 - y_2} = 0.4$$

$$N_{OG} = \left(\frac{1}{1 - \frac{1}{A}} \right) \ln \left[\left(1 - \frac{1}{A} \right) \frac{y_1}{y_2} + \frac{1}{A} \right] = 5.691$$

$$H_{OG} = \frac{H}{N_{OG}} = \frac{3}{5.691} = 0.527 \text{ m}$$

其余条件不变, 操作压力加倍, 导致 $m = \frac{E}{P}$ 减半

因此 $\frac{1}{A'} = \frac{m'G}{L} = 0.2$, 则 $N_{OG}' = \left(\frac{1}{1 - \frac{1}{A'}} \right) \ln \left[\left(1 - \frac{1}{A'} \right) \frac{y_1}{y_2} + \frac{1}{A'} \right] = 4.617$

$$\frac{H_{OG}'}{H_{OG}} = \frac{K_y a}{K_y a'} = \frac{1}{2}, \text{ 所以 } H_{OG}' = 0.2635 \text{ m}$$

则 $H' = H_{OG}' \times N_{OG}' = 1.217 \text{ m}$

6. (1) 已知 $\varphi_0 = 0.6$, $t_0 = 30^\circ\text{C}$, $P_{s0} = 4.25\text{kPa}$, $w_1 = 0.2$, $w_2 = 0.02$

$$H_0 = 0.622 \frac{\varphi_0 \times P_{s0}}{P - \varphi_0 P_{s0}} = 0.0161$$

由于空气经过预热器是等湿过程, 即 $H_0 = H_1$

$$G_c = G_1(1 - w_1) = 400\text{kg/h}$$

$$X_1 = \frac{w_1}{1 - w_1} = 0.25, X_2 = \frac{w_2}{1 - w_2} = 0.0204$$

$$L = \frac{L}{1 + H_0} = 3936.62\text{kg/h}$$

由物料衡算 $L(H_2 - H_1) = G_c(X_1 - X_2) \Rightarrow H_2 = 0.03943\text{kg水气/kg绝干气}$

(2) 由于干燥过程为理想过程, 即为等焓过程 $I_1 = I_2$

$$I_1 = (1.01 + 1.88H_1)t_1 + 2500H_1$$

$$I_2 = (1.01 + 1.88H_2)t_2 + 2500H_2$$

$$\text{解得 } t_1 = 97.75^\circ\text{C}$$

$$(3) Q_p = L(I_1 - I_0) = L(1.01 + 1.88H_0)(t_1 - t_0) = 277445.7\text{kJ/h}$$

2024 年

$$1. (1) u = \frac{V}{A} = \frac{90}{\frac{3.14}{4} \times (0.156)^2 \times 3600} = 1.31\text{m/s}$$

$$Z_2 - Z_1 = 50\text{m}, l + \sum le = 1000\text{m}$$

$$n_1 = 2900\text{r/min}, \lambda = 0.025$$

$$\text{管路特性曲线可表达为: } H_g = \frac{P_2 - P_1}{\rho g} + Z_2 - Z_1 + 8\lambda \frac{l + \sum le}{\pi^2 g d^5} V^2$$