HW 3.5

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14-60) 0.25 kg per person

$4(0.25) = 1.0$ kg/day

$Q = mh_{fg}$

$m = 1.0$ kg

$h_{fg} = 2450$ kJ/kg

$Q = 1.0(2450)$

$Q = 2450$ kJ/day

2450 kJ = 0.68 kWH

14-67) $T_1 = 35°C$

$\phi_1 = 45\%$

$P = 1$ atm

$A = \frac{\pi D^2}{4} = \frac{\pi (0.3)^2}{4} = 0.0707 m^2$

$\dot{V} = AV = 0.0707(18) = 1.273 m^3/s$

$v_1 = 0.90 m^3/kg$ dry air

$\dot{m} = \frac{\dot{V}}{v_1} = \frac{1.273}{0.90} = 1.41 kg/s$

A) $\dot{Q} = 750 kJ/min = 12.5 kJ/s$

$Q = \dot{m} c_p (T_1 - T_2)$

$12.5 = (1.41)(1.005)(35 - T_2)$

$12.5 = 1.417 (35 - T_2)$

$35 - T_2 = 8.82$

$\boxed{T_2 = 26.5°C}$

B) $\omega_2 = \omega_1 = 0.016$

$T_2 = 26.5°C$

$\boxed{\phi_2 = 73.1\%}$

C) $v_2 = 0.87 m^3/kg$

$V_2 = \dot{m} v_2 = 1.41 (0.87) = 1.23 m^3/s$

$V_2 = \frac{V_2}{A} = \frac{1.23}{0.0707} = \boxed{17.5 m/s}$

14-77)

$w_1 = 0.028$ lbm

$h_1 = 42.5$ Btu/lbm

$w_2 = 0.0075$ lbm/lbm dry air

$h_2 = 20.5$ Btu/lbm

A) $\Delta w = w_1 - w_2$

$\Delta w = 0.028 - 0.0075$

$\boxed{\Delta w = 0.0205 \text{ lbm water}}$

B) $q = h_1 - h_2 - (w_1 - w_2) h_f$

$q = 42.5 - 20.5 - (0.0205)(28)$

$q = 22.0 - 0.574$

$\boxed{q = 21.4 \text{ Btu/lbm dry air}}$

14-93) $40^\circ C$, 20%, 1 atm

$\omega_1 = 0.009$ kg/kg dry air

$h_1 = 65$ kJ/kg dry air

$v_1 = 0.90$ m³/kg

$T_2 = 25.5^\circ C$

$\omega_2 = 0.018$ kg/kg dry air

Exit temp: 25.5°C

$\dot{V} = 7$ m³/min

$$\dot{m}_{da} = \frac{\dot{V}}{v_1} = \frac{7}{0.90} = 7.78 \text{ kg/min}$$

$$\dot{m}_w = \dot{m}_{da}(\omega_2 - \omega_1)$$

$$\dot{m}_w = 7.78(0.018 - 0.009)$$

$$\dot{m}_w = 7.78(0.009)$$

$$\boxed{\dot{m}_w = 0.070 \text{ kg/min}}$$

14-100)

System 1

$w_1 = 0.0105$ kg/kg dry air

$h_1 = 62$ kJ

$V_1 = 0.90$ m³/kg

$\dot{m}_{da1} = \frac{15}{0.90} = 16.7$ kg/min

System 2

$w_2 = 0.0065$ kg/kg dry air

$h_2 = 28$ kJ/kg dry air

$V_2 = 0.82$ m³/kg

$\dot{m}_{da2} = \frac{25}{0.82} = 30.5$ kg/min

$\dot{m}_{da3} = 16.7 + 30.5 = 47.2$ kg/min

$$w_3 = \frac{16.7(0.0105) + (30.5)(0.0065)}{47.2} = 0.0088$$

$= 0.0088$ kg H_2O/kg

$$h_3 = \frac{(16.7)(62) + (30.5)(28)}{47.2}$$

$= 40$ kJ/kg

Dry bulb $= 20.2$ °C

Relative Humidity $= 59.7$ %

$V_3 = V_1 + V_2 = 15 + 25$

$= 40.0$ m³/min

14-109)

$\dot{m}_w = 60 \text{ kg/s}$

$\Delta T = 40 - 33 = 7^\circ C$

$Q = \dot{m}_w c_p \Delta T$

$Q = 60(4.18)(7)$

$= 1756 \text{ kW}$

$h_1 = 42 \text{ kJ}$

$W_1 = 0.009$

$V_1 = 0.83$

$h_2 = 100$

$W_2 = 0.027$

$Q = \dot{m}_{da}(h_2 - h_1)$

$1756 = \dot{m}_{da}(100 - 42)$

$\dot{m}_{da} = \frac{1756}{58} = 30.3 \text{ kg/s}$

$\dot{V} = \dot{m}_{da}(V_1)$

$\dot{V} = 30.3(.)$

$\boxed{\dot{V} = 30.3 \text{ m}^3/\text{s}}$

$\dot{m}_{makeup} = \dot{m}_{da}(W_2 - W_1)$

$= 30.3(0.027 - 0.009)$

$= \boxed{0.605 \text{ kg/s}}$