Week 11: Lecture 2

Applications

1. Simple Heating and Cooling

$$\frac{\dot{Q}}{\dot{m}_a} = (h_2^* - h_1^*) \quad (heating)$$

where

$$\begin{aligned} h_1^* &= h_{a,1} + \gamma_1 h_{w_1} \\ h_2^* &= h_{a,2} + \gamma_2 h_{w_2} \end{aligned}$$

2. Heating with Humidification

$$\dot{Q} = \dot{m}_a \; (h_2^* - h_1^*) \quad (heating)$$

where

$$\begin{aligned} \dot{m}_a &= \frac{\dot{V}}{v_{a_a}} \\ v_{a_a} &= \frac{R_a T_1}{P_{a_1}} = \frac{R_a T_1}{(P - P_{w_1})} = \frac{R_a T_1}{(P - \phi_1 P_{sat_1})} \end{aligned}$$

and

$$\dot{m}_{steam} = \dot{m}(\gamma_3 - \gamma_2)$$

3. Evaporative Cooling

$$h_1^* + \underbrace{(\gamma_2 - \gamma_1)h_\ell}_{\text{negligible}} = h_2^*$$

Therefore

$$h_1^* = h_2^*$$

Week 11: Lecture 2

4. Mixing of Two Moist Air Streams

$$\frac{\dot{m}_{a,1}}{\dot{m}_{a,2}} = \frac{h_2^* - h_3^*}{h_3^* - h_1^*} = \frac{\gamma_2 - \gamma_3}{\gamma_3 - \gamma_1}$$

where

$$\begin{aligned} \dot{m}_{a,1} &= \rho_{a_1}\ \dot{V}_1 \\ \dot{m}_{a,2} &= \rho_{a_2}\ \dot{V}_2 \end{aligned}$$