Week 11: Lecture 2

Applications

1. Simple Heating and Cooling

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

where

$$h_1^* = h_{a,1} + \gamma_1 h_{w_1}$$

$$h_2^* = h_{a,2} + \gamma_2 h_{w_2}$$

2. Heating with Humidification

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

where

$$\dot{m}_a = \frac{\dot{V}}{v_{a_a}}$$

$$v_{a_a} = \frac{R_a T_1}{P_{a_1}} = \frac{R_a T_1}{(P - P_{w_1})} = \frac{R_a T_1}{(P - \phi_1 P_{sat_1})}$$

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

$$h_1^* = h_2^*$$

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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

$$\dot{m}_{a,1} = \rho_{a_1} \dot{V}_1$$

$$\dot{m}_{a,2} = \rho_{a_2} \dot{V}_2$$