44.2 **$5000 cfm$ of outside air at $90°F$ and 80% RH enters the cooling coil of a dedicated outside air handling unit. The unit supplies tempered air at $62°F$ dry bulb and $60°F$ wet bulb. What is the volume flow rate of condensate removed by the unit?**

A. $0.4 gpm$

B. $0.5 gpm$

C. $0.6 gpm$

D. $0.7 gpm$

Both states are fully defined. Use the Psychrometric Chart to obtain the humidity ratio for both the entering outside air and the tempered leaving air. Also look up the specific volume for the entering air:

For State 1:

$$T_1 = 90°F$$

$$\phi_1 = 80\%$$

$$\omega_1 = 0.02469 \frac{lb_w}{lb_{da}}$$

$$v_1 = 14.46 \frac{ft^3}{lb}$$

For State 2:

$$T_{2,db} = 62°F$$

$$T_{2,wb} = 60°F$$

$$\omega_2 = 0.01062 \frac{lb_w}{lb_{da}}$$

Calculate the change in humidity ratio:

$$\Delta\omega = \omega_1 - \omega_2 = 0.02469 \frac{lb_w}{lb_{da}} - 0.01062 \frac{lb_w}{lb_{da}} = 0.01407 \frac{lb_w}{lb_{da}}$$

Use the specific volume at state 1 to solve for the mass flow rate of air entering the coil:

$$\dot{m}_a = \rho Q = \frac{Q}{v} = \frac{5000 \frac{ft^3}{min}}{14.46 \frac{ft^3}{lb}} = 345.8 \frac{lb_a}{min}$$

Apply the definition of the humidity ratio to solve for the mass flow rate of water i.e. condensate removed from the air:

$$\dot{m}_w = \dot{m}_a \Delta\omega$$

$$\dot{m}_w = \left(345.8 \frac{lb}{min}\right)\left(0.01407 \frac{lb_w}{lb_{da}}\right) = 4.865 \frac{lb_w}{min}$$

Use the density of water to convert the mass flow rate to a volume flow rate:

$$Q_{condensate} = \frac{\dot{m}_w}{\rho} = \left(\frac{4.865 \frac{lb}{min}}{62.4 \frac{lb}{ft^3}}\right)\left(7.48 \frac{gal}{ft^3}\right) = 0.583 gpm$$

Answer C