36.14 Air at $90°F$ dry bulb and $75°F$ wet bulb enters a cooling tower and leaves at $80°F$ saturated. What is the change in moisture content per cubic foot of air?

A. $0.0005 \frac{lb_w}{ft^3}$

B. $0.007 \frac{lb_w}{ft^3}$

C. $0.4 \frac{lb_w}{ft^3}$

D. $5.2 \frac{lb_w}{ft^3}$

Refer to the entering air condition as state 1 and the leaving air condition as state 2. Both states are fully defined. Use the Psychrometric Chart to find the humidity ratio for both states, then calculate the difference. Also find the specific volume for state 1.

$$T_{1,db} = 90°F$$

$$T_{1,wb} = 75°F$$

$$\omega_1 = 0.0153 \frac{lb_w}{lb_{da}}$$

$$v_1 = 14.2 \frac{ft^3}{lb_{da}}$$

$$T_{2,db} = 80°F$$

$$T_{2,wb} = 80°F$$

$$\omega_2 = 0.0223 \frac{lb_w}{lb_{da}}$$

$$\Delta\omega = \omega_2 - \omega_1 = 0.0223 \frac{lb_w}{lb_{da}} - 0.0153 \frac{lb_w}{lb_{da}} = .007 \frac{lb_w}{lb_{da}}$$

In order to express the humidity per unit volume rather than per unit mass of dry air, divide $\Delta\omega$ by the specific volume of the entering air, v_1. The reference handbook calls this the Absolute Humidity or Water Vapor Density, d_v.

$$d_v = \frac{.007 \frac{lb_w}{lb_{da}}}{14.2 \frac{ft^3}{lb_{da}}} = 0.0005 \frac{lb_w}{ft^3}$$

Answer A