Simple Heating and Cooling

14-67C Relative humidity decreases during a simple heating process and increases during a simple cooling process. Specific humidity, on the other hand, remains constant in both cases.

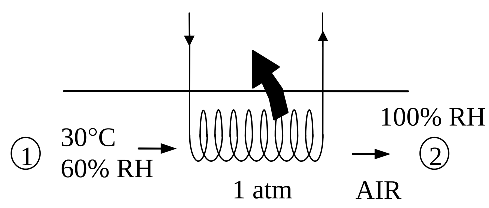
14-68C Because a horizontal line on the psychrometric chart represents a ω = constant process, and the moisture content ω of air remains constant during these processes.

14-69 Humid air at a specified state is cooled at constant pressure to the dew-point temperature. The cooling required for this process is to be determined.

Assumptions **1** This is a steady-flow process and thus the mass flow rate of dry air remains constant during the entire process $(\dot{m}_{a1} = \dot{m}_{a2} = \dot{m}_a)$. **2** Dry air and water vapor are ideal gases. **3** The kinetic and potential energy changes are negligible.

Analysis The amount of moisture in the air remains constant ($\omega_1 = \omega_2$) as it flows through the cooling section since the process involves no humidification or dehumidification. The inlet and exit states of the air are completely specified, and the total pressure is 1 atm. The properties of the air at the inlet state are determined from the psychrometric chart (Figure A-31) to be

$$\begin{aligned} h_1 &= 71.3\ \text{kJ/kg dry air} \\ \omega_1 &= 0.0161\ \text{kg H}_2\text{O/kg dry air} \ (= \omega_2) \\ T_{\text{dp},1} &= 21.4°\text{C} \end{aligned}$$



The exit state enthalpy is

$$\left.\begin{aligned} P &= 1\ \text{atm} \\ T_2 &= T_{\text{dp},1} = 21.4°\text{C} \\ \phi_2 &= 1 \end{aligned}\right\} h_2 = 62.4\ \text{kJ/kg dry air}$$

From the energy balance on air in the cooling section,

$$q_{\text{out}} = h_1 - h_2 = 71.3 - 62.4 = \mathbf{8.9\ kJ/kg\ dry\ air}$$