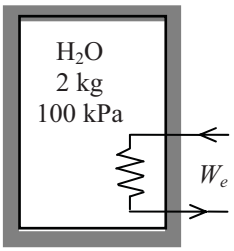
8-39 An insulated rigid tank contains a saturated liquid-vapor mixture of water at a specified pressure. An electric heater inside is turned on and kept on until all the liquid vaporized. The entropy change of the water during this process is to be determined.

Analysis From the steam tables (Tables A-4 through A-6)



$$\left.\begin{array}{l} P_1 = 100 \text{ kPa} \\ x_1 = 0.25 \end{array}\right\} \begin{array}{l} v_1 = v_f + x_1 v_{fg} = 0.001 + (0.25)(1.6941 - 0.001) = 0.4243 \text{ m}^3/\text{kg} \\ s_1 = s_f + x_1 s_{fg} = 1.3028 + (0.25)(6.0562) = 2.8168 \text{ kJ/kg} \cdot \text{K} \end{array}$$

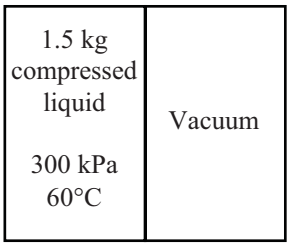
$$\left.\begin{array}{l} v_2 = v_1 \\ \text{sat. vapor} \end{array}\right\} s_2 = 6.8649 \text{ kJ/kg} \cdot \text{K}$$

Then the entropy change of the steam becomes

$$\Delta S = m(s_2 - s_1) = (2 \text{ kg})(6.8649 - 2.8168) \text{ kJ/kg} \cdot \text{K} = \mathbf{8.10\ kJ/K}$$

8-40 CD EES A rigid tank is divided into two equal parts by a partition. One part is filled with compressed liquid water while the other side is evacuated. The partition is removed and water expands into the entire tank. The entropy change of the water during this process is to be determined.

Analysis The properties of the water are (Table A-4)



$$\left.\begin{array}{l} P_1 = 300 \text{ kPa} \\ T_1 = 60°\text{C} \end{array}\right\} \begin{array}{l} v_1 \cong v_{f@60°\text{C}} = 0.001017 \text{m}^3/\text{kg} \\ s_1 = s_{f@60°\text{C}} = 0.8313 \text{ kJ/kg} \cdot \text{K} \end{array}$$

Noting that

$$v_2 = 2v_1 = (2)(0.001017) = 0.002034 \text{ m}^3/\text{kg}$$

$$\left.\begin{array}{l} P_2 = 15 \text{ kPa} \\ v_2 = 0.002034 \text{ m}^3/\text{kg} \end{array}\right\} \begin{array}{l} x_2 = \dfrac{v_2 - v_f}{v_{fg}} = \dfrac{0.002034 - 0.001014}{10.02 - 0.001014} = 0.0001018 \\ s_2 = s_f + x_2 s_{fg} = 0.7549 + (0.0001018)(7.2522) = 0.7556 \text{ kJ/kg} \cdot \text{K} \end{array}$$

Then the entropy change of the water becomes

$$\Delta S = m(s_2 - s_1) = (1.5 \text{ kg})(0.7556 - 0.8313) \text{kJ/kg} \cdot \text{K} = \mathbf{-0.114\ kJ/K}$$