Answer on Question #73329-Physics-Molecular Physics-Thermodynamics

A mixture of saturated water and saturated steam at a temperature of 300°C is contained in a closed vessel of 0.1 m3 capacity. If the mass of saturated water is 1kg find the mass of steam in the vessel. Also find the pressure, specific volume, dryness fraction and enthalpy of the mixture.

Solution

At 300°C:

$$v_w = 1.40369 \cdot 10^{-3} \frac{m^3}{kg}.$$

$$V_W = v_w m_w = 1.40369 \cdot 10^{-3}(1) = 1.40369 \cdot 10^{-3}\ m^3.$$

$$V_g = 0.1 - 1.40369 \cdot 10^{-3} = 0.098596\ m^3.$$

The mass of steam in the vessel is

$$m_g = V_g \rho_g = (0.098596)(46.1538) = 4.55\ kg.$$

$$v_g = 0.0216667 \frac{m^3}{kg}$$

$$v = (1 - x)v_w + xv_g$$

$$v = v_w - xv_w + xv_g$$

$$v = \frac{V}{m} = \frac{0.1}{1 + 4.55} = 0.01802$$

Mixture

Dryness fraction:

$$x = \frac{v - v_w}{v_g - v_w} = \frac{0.01802 - 1.40369 \cdot 10^{-3}}{0.0216667 - 1.40369 \cdot 10^{-3}} = 0.82\ or\ 82\%.$$

Pressure is

$$p = 84.8\ bar.$$

Specific volume is

$$v = 0.01802 \frac{m^3}{kg}$$

Enthalpy is

$$H = hm = (2.496 \cdot 10^6)(1 + 4.55) = 13.85\ MJ.$$