

Answer on Question #66213, Physics / Solid State Physics

For a specific volume of 0.2 m³/kg, find the quality of steam if the absolute pressure is (a) 40 kPa and (b) 630 kPa. What is the temperature of each case?

Find: $x - ?$ $T - ?$

Given:

$$v=0.2 \text{ m}^3/\text{kg}$$

$$p_1=40 \text{ kPa}$$

$$p_2=630 \text{ kPa}$$

Solution:

(a) Using information from Table (Properties of Saturated H₂O-Pressure Table), we calculate the quality as follows:

$$v = v_f + x(v_g - v_f) \quad (1)$$

$$\text{Of (1)} \Rightarrow 0.2 = 0.001 + x(3.993 - 0.001) \quad (2)$$

$$\text{Of (2)} \Rightarrow x=0.04985$$

The temperature is found in Table next to the pressure entry: $T = 75.9^\circ\text{C}$.

(b) We must interpolate to find the correct values in Table. Using the values at 0.6 and 0.8 MPa we have:

$$v_g = \left(\frac{0.03}{0.2}\right) \times (0.2404 - 0.3157) + 0.3157 = 0.3044 \quad (3)$$

$$v_f=0.0011 \quad (4)$$

$$(3) \text{ and (4) in (1): } 0.2 = 0.0011 + x(0.3044 - 0.0011) \quad (5)$$

$$\text{Of (5)} \Rightarrow x=0.6558$$

The temperature is interpolated to be:

$$T = \left(\frac{0.03}{0.2}\right) \times (170.4 - 158.9) + 158.9 = 160.6^\circ\text{C}$$

Answer:

(a) $x=0.04985, T = 75.9^\circ\text{C};$

(b) $x=0.6558; T = 160.6^\circ\text{C}$

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