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Loose Leaf for Fluid Mechanics Fundamentals and Applications | (3rd Edition)

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Chapter 2, Problem 36P

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Problem

Saturated water vapor at 150°C (enthalpy $h = 2745.9$ kJ/kg) flows in a pipe at 50 m/s at an elevation of $z = 10$ m. Determine the total energy of vapor in J/kg relative to the ground level.

Step-by-step solution

Step 1 of 2

Write the relation for the total energy of a flowing fluid.

$$e_{\text{flowing}} = h + \frac{V^2}{2} + gz$$

Here, h is the enthalpy, V is the magnitude of velocity, g is the acceleration due to gravity, and z is the elevation of the system with respect to the reference point.

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Step 2 of 2

Calculate the total energy of the vapor relative to the ground level:

$$e_{\text{flowing}} = h + \frac{V^2}{2} + gz$$

Substitute 2745.9×10^3 J/kg for h , 50 m/s for V , 9.81 m/s² for g , and 10 m for z .

$$\begin{aligned} e_{\text{flowing}} &= (2745.9 \times 1000) + \frac{50^2}{2} + (9.81 \times 10) \\ &= 2745900 + 1250 + 98.1 \\ &= 2747248.1 \text{ J/kg} \end{aligned}$$

$$e_{\text{flowing}} = 2747.248 \text{ kJ/kg}$$

Therefore, the total energy of the vapor relative to the ground level is 2747.248 kJ/kg.

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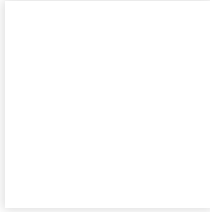
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Chapter 2, Problem 92P

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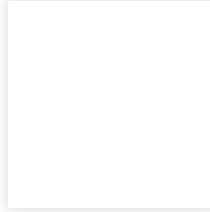
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