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

Chapter 2, Problem 36P | Bookmark | Show all steps: ON

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.

Comment

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 $2745.9\times10^3\ \text{J/kg}$ for h, $50\ \text{m/s}$ for V, $9.81\ \text{m/s}^2$ for g, and $10\ \text{m}$ for z.

$$\begin{aligned} e_{\text{flowing}} &= (2745.9\times1000) + \frac{50^2}{2} + (9.81\times10) \\ &= 2745900 + 1250 + 98.1 \\ &= 2747248.1\ \text{J/kg} \\ e_{\text{flowing}} &= 2747.248\ \text{kJ/kg} \end{aligned}$$

Therefore, the total energy of the vapor relative to the ground level is $\boxed{2747.248\ \text{kJ/kg}}$.

Comments (1)

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Chapter 2, Problem 92P

A large plate is pulled at a constant speed of U = 4 m/s over a fixed plate on 5-mm-thick engine oil film at 20°C. Assuming a...

See solution

Chapter 2, Problem 110P

Nutrients dissolved in water are carried to upper parts of plants by tiny tubes partly because of the capillary effect....

See solution

See more problems in subjects you study