Example 7.3-1 Carbon Dioxide Evaporating in a Tube.EEZ

Equations

EXAMPLE 7.3-1

Heat Transfer
G.F. Nellis and S.A. Klein
Cambridge University Press, 2009

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$UnitSystem SI MASS RAD PA K J
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$Tabstops 0.2 0.4 0.6 3.5 in
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$F\$ =$ 'CarbonDioxide' fluid type (1)

$D = 2.5\ [\text{mm}] \cdot \left|0.001\ \frac{\text{m}}{\text{mm}}\right|$ tube inner diameter (2)

$L = 2\ [\text{m}]$ tube length (3)

$p_{sat} = 3.2\ [\text{MPa}] \cdot \left|1000000\ \frac{\text{Pa}}{\text{MPa}}\right|$ boiling saturation pressure (4)

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$ifnot ParametricTable
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$x = 0.5$ quality (5)

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$endif
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$ifnot ParametricTable='Table 2'
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$G = 200\ \left[\text{kg/s}\cdot\text{m}^2\right]$ mass velocity (6)

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$endif
```

$T_{sat} = \text{T}_{\text{sat}}\left(F\$,\ \text{P} = \text{P}_{\text{sat}}\right)$ saturation temperature (7)

$i_{v,sat} = \text{h}\left(F\$,\ \text{T} = T_{sat},\ \text{x} = 1\right)$ specific enthalpy of saturated vapor (8)

$i_{l,sat} = \text{h}\left(F\$,\ \text{T} = T_{sat},\ \text{x} = 0\right)$ specific enthalpy of saturated liquid (9)

$\Delta i_{vap} = i_{v,sat} - i_{l,sat}$ enthalpy change of vaporization (10)

$\dot{q} = G \cdot \pi \cdot \frac{D^2}{4} \cdot \Delta i_{vap}$ rate of heat transfer (11)

$\dot{q''}_s = \frac{\dot{q}}{(\pi \cdot D \cdot L)}$ heat flux (12)

call $Flow_{Boiling}\left(F\$,\ T_{sat},\ G,\ D,\ x,\ \dot{q''}_s,\ \text{'Horizontal'}\ : h,\ T_w\right)$ heat transfer coefficient (13)

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$if ParametricTable='table 2'
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$\bar{h} = G \cdot D \cdot \Delta i_{vap} \cdot \frac{\int_0^1 h\ \text{d}x}{\left(4 \cdot L \cdot \dot{q''}_s\right)}$ average heat transfer coefficient (14)

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$endif
```

Plot Window 2: $\bar{h}$ *vs heat* $flux$