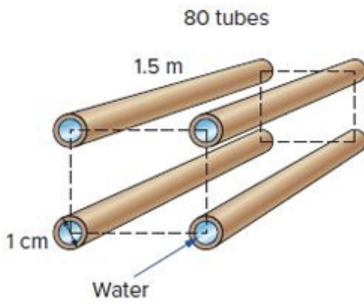


//QUESTION 5



//Given

```
T_avg=60[C]
V_dot=15[L/s]*convert(L/s;m^3/s)
N_brass=80[dim]
D_i=1[cm]*convert(cm;m)
L_brass=1,5[m]
e_brass=0,0013[mm]*convert(mm;m)
```

//Assumption saturated water at 60 C
x=0[dim]

```
nu=kinematicviscosity(Water,T=T_avg;x=x)
```

```
A_brass=pi*(D_i^2)/4
A_total=A_brass*N_brass
```

```
V=V_dot/A_total
```

//Checking the type of flow
R_e=(V*D_i)/nu

//Re>40*10^5 , the flow

```
(1/sqrt(f))+2*log10((e_brass/D_i)/3,7 +2,51/(R_e*sqrt(f)))=0
```

```
rho=density(Water,T=T_avg;x=x)
```

```
DELTAP=f*(L_brass/D_i)*(rho*V^2/2)
```

```
W_dot_in=V_dot*DELTAP
```

$T_{avg} = 60 \text{ [C]}$

$\dot{V} = 15 \text{ [L/s]} \cdot \left| 0,001 \cdot \frac{\text{m}^3/\text{s}}{\text{L/s}} \right|$

$N_{brass} = 80 \text{ [dim]}$

$$D_i = 1 \text{ [cm]} \cdot \left| 0,01 \cdot \frac{\text{m}}{\text{cm}} \right|$$

$$L_{\text{brass}} = 1,5 \text{ [m]}$$

$$e_{\text{brass}} = 0,0013 \text{ [mm]} \cdot \left| 0,001 \cdot \frac{\text{m}}{\text{mm}} \right|$$

$$x = 0 \text{ [dim]}$$

$$\nu = \text{KinematicViscosity}(\text{Water}; T = T_{\text{avg}}; x = x)$$

$$A_{\text{brass}} = \pi \cdot \frac{D_i^2}{4}$$

$$A_{\text{total}} = A_{\text{brass}} \cdot N_{\text{brass}}$$

$$V = \frac{\dot{V}}{A_{\text{total}}}$$

$$R_e = \frac{V \cdot D_i}{\nu}$$

$$\frac{1}{\sqrt{f}} + 2 \cdot \log \left[\frac{e_{\text{brass}}}{D_i \cdot 3,7} + \frac{2,51}{R_e \cdot \sqrt{f}} \right] = 0$$

$$\rho = \rho(\text{Water}; T = T_{\text{avg}}; x = x)$$

$$\Delta P = f \cdot \frac{L_{\text{brass}}}{D_i} \cdot \rho \cdot \frac{V^2}{2}$$

$$\dot{W}_{\text{in}} = \dot{V} \cdot \Delta P$$

SOLUTION

Unit Settings: SI C kPa kJ mass deg

$$A_{\text{brass}} = 0,00007854 \text{ [m}^2\text{]}$$

$$D_i = 0,01 \text{ [m]}$$

$$L_{\text{brass}} = 1,5 \text{ [m]}$$

$$\rho = 983,2 \text{ [kg/m}^3\text{]}$$

$$V = 2,387 \text{ [m/s]}$$

$$x = 0 \text{ [dim]}$$

$$A_{\text{total}} = 0,006283 \text{ [m}^2\text{]}$$

$$e_{\text{brass}} = 0,0000013 \text{ [m]}$$

$$\nu = 4,740\text{E-}07 \text{ [m}^2\text{/s]}$$

$$R_e = 50366 \text{ [dim]}$$

$$\dot{V} = 0,015 \text{ [m}^3\text{/s]}$$

$$\Delta P = 8960 \text{ [Pa]}$$

$$f = 0,02132 \text{ [dim]}$$

$$N_{\text{brass}} = 80 \text{ [dim]}$$

$$T_{\text{avg}} = 60 \text{ [C]}$$

$$\dot{W}_{\text{in}} = 134,4 \text{ [W]}$$

No unit problems were detected.