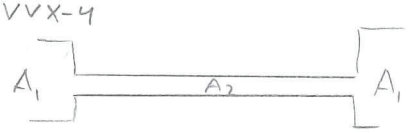
VVX-4



Bestäm tryckfallet i kylaren med 10 st 5m långa, parallella stålrör. Innerdiameter 50 mm

Bernoullis ekvation:

$$\cancel{\rho g y_1} + \frac{v_1^2 \rho}{2} + p_1 = \cancel{\rho g y_2} + \frac{v_2^2 \rho}{2} + \rho g h_L + p_2$$

$$\Rightarrow p_1 - p_2 = \Delta p = \rho g h_L = \rho g (h_{L,in} + h_{L,ut} + h_{L,rör}) =$$

$$= \rho \cancel{g} \left(K_{in} \frac{v^2}{2\cancel{g}} + K_{ut} \frac{v^2}{2\cancel{g}} + 2 f_f \frac{L}{D} \frac{v^2}{\cancel{g}} \right) = \rho K_{in} \frac{v^2}{2} + \rho K_{ut} \frac{v^2}{2} + 2\rho f_f \frac{L v^2}{D} = (1)+(2)+(3)$$

$$Q_{rör} = \frac{110}{10} = 11 \text{ m}^3/\text{h} = 0{,}003056 \text{ m}^3/\text{s}. \quad v = \frac{Q_{rör}}{A} = \frac{Q_{rör}}{\pi \cdot \frac{0{,}05^2}{4}} = 1.5562 \text{ m/s}$$

$\rho(60°C) = 983{,}2 \text{ kg/m}^3$ $\quad \mu(60°C) = 469 \cdot 10^{-6} \text{ Pas}$

$K_{in} = \left\{ \frac{A_2}{A_1} \approx 0 \right\} = 0{,}5$ $\quad K_{ut} = \left\{ \frac{A_1}{A_2} \approx 0 \right\} = 1.0$

$\frac{e}{D} = \left\{ \begin{matrix} e = 0.00015 \\ D = 5\text{cm} \approx 2\text{ in} \end{matrix} \right\} = 0.0012 \Rightarrow \left\{ \begin{matrix} e/D = 0.0012 \\ Re = \frac{\rho v D}{\mu} = 1{,}63 \cdot 10^5 \end{matrix} \right\} \Rightarrow f_f = 0{,}005129$

$$(1) = \rho K_{in} \frac{v^2}{2} = 983{,}2 \cdot 0{,}5 \cdot \frac{1{,}5562^2}{2} = 595 \text{ Pa}$$

$$(2) = \rho K_{ut} \frac{v^2}{2} = 983{,}2 \cdot 1.0 \cdot \frac{1{,}5562^2}{2} = 1191 \text{ Pa}$$

$$(3) = 2\rho f_f \frac{L}{D} v^2 = 2 \cdot 983{,}2 \cdot 0{,}005129 \cdot \frac{5}{0.05} \cdot 1{,}5562^2 = 2442 \text{ Pa}$$

$$\Rightarrow \Delta p = (1) + (2) + (3) = 4228 \text{ Pa}$$

Svar: $\Delta p = 4{,}23$ kPa