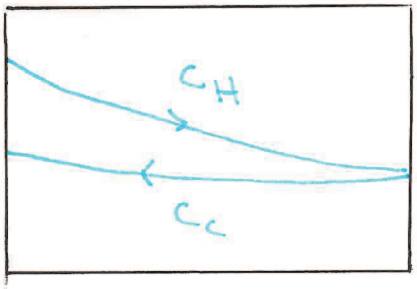
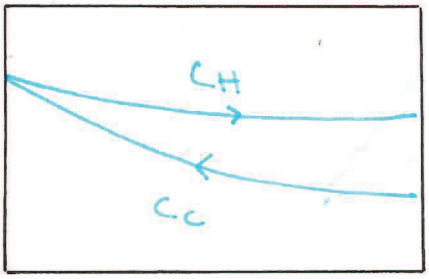
Demoövn. 7

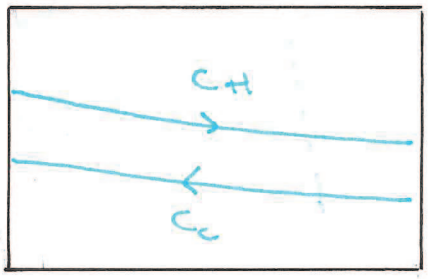
Tors LV6



$C_{min} = C_H$



$C_{min} = C_c$



$C_{min} = C_c = C_H = C_{max}$

Pump 4

$L = 2000$ m längd $\quad d = 0.06$ m diameter

$\Delta h = 0$ höjdskillnad

$c = 1.5$ m/s flödeshastighet

$\xi = 0.5$ motstånd krök 18 st. krökar!

$\lambda = 0.0274$ friktion i rör {typ ytråhet? ...}

$\eta_{pump} = 0.8$

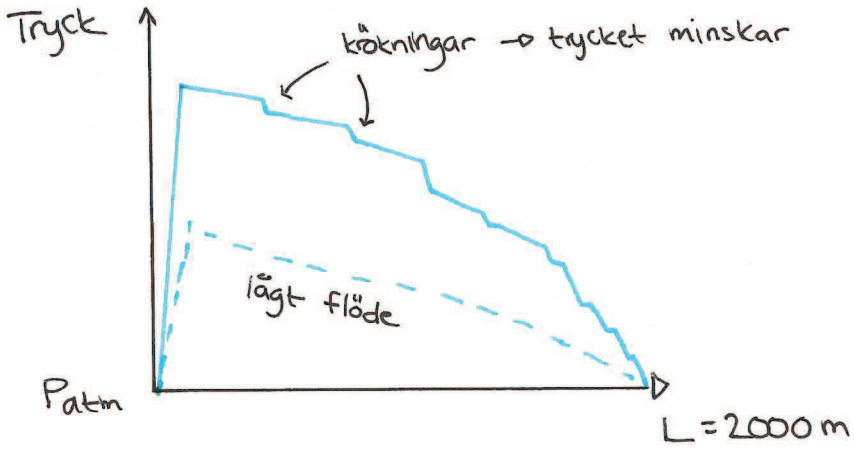
$$\eta_{pump} = \frac{P_{nyttig}}{P_{pump}} = \frac{\dot{V} \cdot \overbrace{\Delta P_{pump}}^{\text{tryckskillnad}}}{\underbrace{P_{pump}}_{\text{effekt}}} = \frac{\dot{V} \rho g H}{P_{pump}} \quad \text{(ekv 17)}$$

Steg 1 Beräkna P_{syst} (tryck) för att veta vad pumpen bör leverera

$$\Delta P_{syst} = P_2 - P_1 + \rho g (h_2 - h_1) + \frac{c_2^2 - c_1^2}{2} \rho + \Delta p_{f_{12}}$$

$\{P_{atm} = P_1 = P_2\}$ $\{\Delta h = 0\}$ $\{c_2 = c_1\}$

$$\rightarrow \Delta P_{syst} = \Delta P_{f_{12}} = \Delta P_{pump}$$



$$\Delta P_{f_{12}} = \left(\lambda \frac{L}{d} + \sum_i \zeta_i\right) \frac{c^2}{2} \rho =$$

$$= \left(0.0274 \cdot \frac{2000}{0.06} + 18 \cdot 0.5\right) \frac{1.5^2}{2} \cdot 1000 =$$

$$= 1037.6 \text{ kPa} \quad (\simeq 1 \text{ MPa})$$

Obs! 1 bar ≈ 10 m H_2O

Bra att komma ihåg ifall man vill kolla rimligheten i ett tryckfall osv.

effekt

$$P_{pump} = \frac{\dot{V} \Delta P_{pump}}{\eta_{pump}} = \left\{ c \cdot A_{tvärsnitt} \right\} = \frac{1.5 \cdot \frac{0.06^2}{4} \pi \cdot 1037.6 \cdot 10^3}{0.8}$$

$$P_{pump} = 5.5 \text{ kW}$$

Pump 6

$L = 100\ m$ $\quad \lambda = 0.025$

$\Delta h = 30\ m$ $\quad \zeta = \text{ca } 1.0$ engångsmots. (in- och utlopp)

$d = 0.15\ m$ $\quad \rho = 1000\ \frac{kg}{m^3}$ (H_2O)

$\dot{V} = 0.035\ \frac{m^3}{s}$

Sökt: ~~P_{pump}~~ Pump rätt vald?

$$H_{sys} = \frac{P_2 - P_1}{\rho g} + (h_2 - h_1) + \frac{c_2^2 - c_1^2}{2g} + h_{f_{12}} =$$

$\{P_{atm} = P_1 = P_2\}$ $\quad \{c_1 = c_2\}$ $\quad = \frac{\Delta P_{f_{12}}}{\rho g}$

$$= 30 + \frac{\Delta P_{f_{12}}}{\rho g}$$

statiskt tryckfall

dynamiskt tryckfall, beroende av c

$$c = \frac{\dot{V}}{A_{tvär}} = \frac{\dot{V}}{\frac{0.15^2}{4}\pi} = 56.59\,\dot{V}$$

$$\Delta P_{f_{12}} = \left(\lambda \frac{L}{D} + \sum_i \zeta_i\right) \frac{c^2}{2} \rho =$$

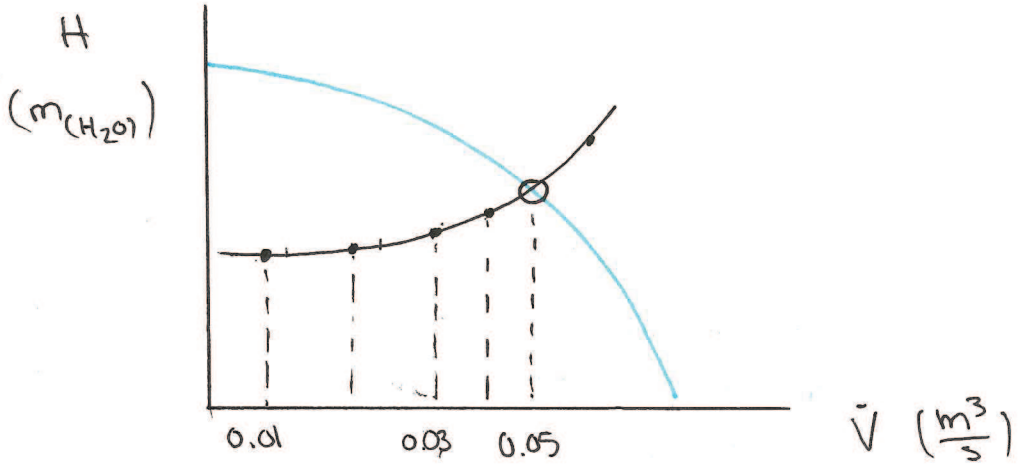
$$= \left(0.025 \cdot \frac{100}{0.15} + 2\right) \frac{3202.43\,\dot{V}^2}{2} \cdot 1000$$

$$= 59.78 \cdot 10^6\ \frac{\dot{V}^2}{2} = 29.889 \cdot 10^6 \cdot \dot{V}^2$$

$$H_{sys} = 30 + \frac{29.889\,V^2}{1000 \cdot 9.81} = 30 + 3046.8\,\dot{V}^2$$

Beräkna punkter $0 \rightarrow 0.06 \frac{m^3}{s}$

$\dot{V}$ $[\frac{m^3}{s}]$	H_{sys} $[m(H_2O)]$
0	30
0.02	31.22
0.04	34.78
0.06	40.97



Fick inte flödet vi ville ha !!

(Fick $\dot{V} = 0.06 \frac{m^3}{s}$ → Vill $\dot{V} = 0.035 \frac{m^3}{s}$)

Bör varvtalsreglera (?) ty pumpen behöver inte leverera lika högt tryck, jämfört om vi ströp flödet!