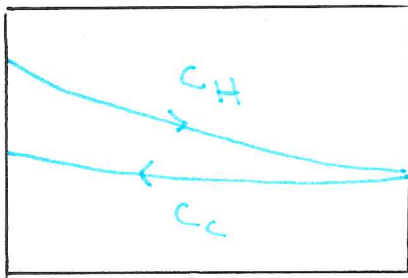
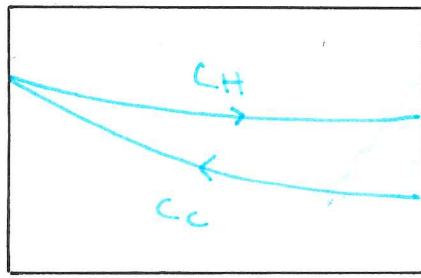


Demoöv. 7

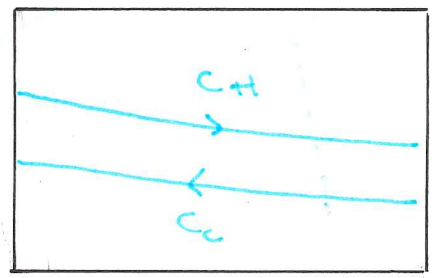
Tors LV6



$$C_{\min} = C_H$$



$$C_{\min} = C_C$$



$$C_{\min} = C_C = C_H = C_{\max}$$

Pump 4

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

$\Delta h = 0$ höjdskillnad

$c = 1.5$ m/s flödes hastighet

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

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

$\eta_{\text{pump}} = 0.8$

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

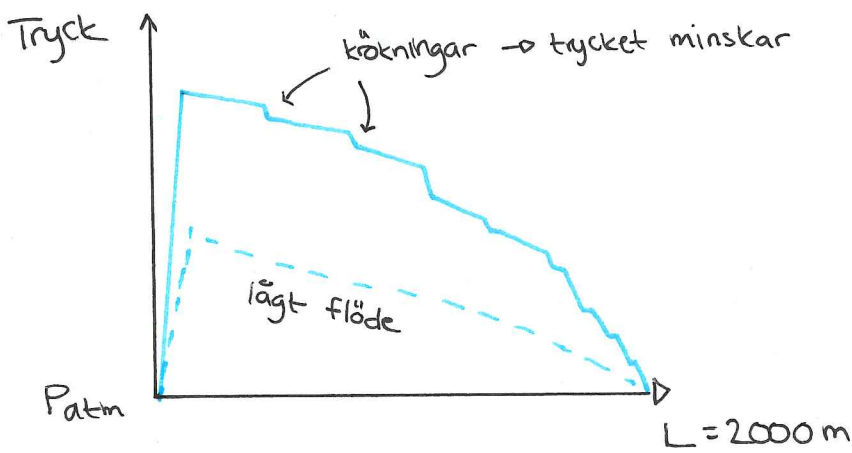
Steg 1

Beräkna P_{sys} (tryck) för att veta vad pumpen bör leverera

$$\Delta P_{\text{sys}} = P_2 - P_1 + \rho g (h_2 - h_1) + \frac{c_2^2 - c_1^2}{2} \rho + \Delta P_{f12}$$

$\left\{ P_{\text{atm}} = P_1 = P_2 \right\} \quad \left\{ \Delta h = 0 \right\} \quad \left\{ c_2 = c_1 \right\}$

$\rightarrow \Delta P_{\text{sys}} = \Delta P_{f12} = \Delta P_{\text{pump}}$



$$\Delta P_{f12} = \left(\lambda \frac{L}{d} + \sum_i \xi_i \right) \frac{c^2}{2} \rho =$$

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

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

Obs! 1 bar \approx 10 m H₂O

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

effect

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

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

Pump 6

$$L = 100 \text{ m}$$

$$\lambda = 0.025$$

$$\Delta h = 30 \text{ m}$$

$$\sum \zeta = 2$$

engångsmets. (in- och utlopp)

$$d = 0.15 \text{ m}$$

$$\rho = 1000 \frac{\text{kg}}{\text{m}^3} \text{ (H}_2\text{O)}$$

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

öskt: $\frac{P_{\text{pump}}}{P_{\text{pump}}}$ rätt vald?

$$H_{\text{sys}} = \frac{P_2 - P_1}{\rho g} + (h_2 - h_1) + \frac{c_2^2 - c_1^2}{2g} + h_{f12} =$$

$\left\{ P_{\text{atm}} = P_1 = P_2 \right\}$ $\left\{ c_1 = c_2 \right\}$ $= \frac{\Delta P_{f12}}{\rho g}$

$$= 30 + \frac{\Delta P_{f12}}{\rho g}$$

statiskt tryckfall

dynamiskt tryckfall, beroende av c

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

$$\Delta P_{f12} = \left(\lambda \frac{L}{D} + \sum_i \zeta_i \right) \frac{c^2}{2} \rho =$$

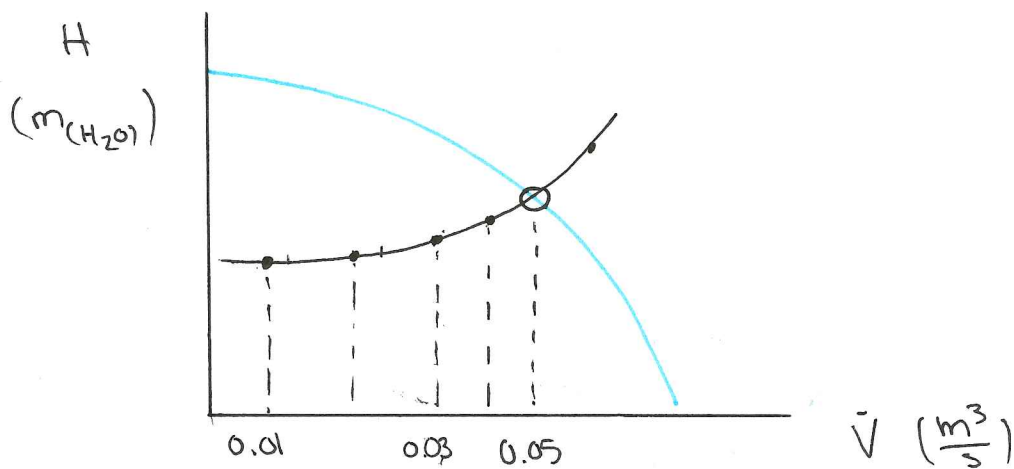
$$= \left(0.025 \cdot \frac{100}{0.15} + 2 \right) \frac{3202.43 \dot{V}^2}{2} \cdot 1000$$

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

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

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

$\dot{V} [\frac{\text{m}^3}{\text{s}}]$	$H_{\text{sys}} [\text{m}(\text{H}_2\text{O})]$
0	30
0.02	31.22
0.04	34.78
0.06	40.97



Fick inte flödet vi ville ha !!

(Fick $\dot{V} = 0.06 \frac{\text{m}^3}{\text{s}} \rightarrow$ vill $\dot{V} = 0.035 \frac{\text{m}^3}{\text{s}}$)

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