Volumetric Pumps and Compressors

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Name: .....

1 Piston pump design

- Design a piston pump based on the data below. The result of the design are (a) piston area, (b) stroke and (c) driving motor revolution number and power. The revoltuion number should be max. 200 rpm.

- Provide a minimal connecting rod diameter to avoid buckling!

- Assuming $\delta = 5\%$ allowed pulsation level, design a pulsation dampener (nominal gas volume V_0). Use the mean system pressure as mean pressure and isothermal process.

- Plot the following diagrams for two periods: $Q_{pump}(t)$, $Q_{PD}(t)$, $V_{air,PD}(t)$ and $p_{air,PD}(t)$. (PD = pulsation dampener)

- Assuming ambient tank pressure and H geodetical height difference between the fluid surface and the pump suction side, L pipe length (see the table below) and $\lambda = 0.02$ friction factor, find the minimum pipe diameter required to avoid cavitation. Choose the next standard diameter.

type: single duplex triplex

data set: ....

	A	B	C
mean flow rate [l/min]	20	40	80
mean system pressure [bar]	50	100	150
H [m] (geod. height diff.)	1	3	1
L[m] (pipe length)	4	2	1

Table 1: Data set for piston pump design.

2 Hydraulic circuit design

- The components of a hydraulic circuit are to be chosen. Data are given in Table 2. In this case you have to pick real elements from any manufacturers. When submitting the homework, attach the corresponding catalogue pages.
- Choose a motor/cylinder that matches the requirements.
- Choose a pump and a pressure relief valve.
- Suggest a control technique (throttle valve connected in series or parallel) based on the efficiency.
- Make a proper sketch on the $Q - \Delta p$ plane of the operating point and performance curves.

data set: ....

	A	B	C	D
motor torque [Nm]	100	160	-	-
motor revolution number [rpm]	1500	1800	-	-
cylinder force [kN]	-	-	20	40
cylinder velocity [m/s]	-	-	1	0.5
driving motor rev. num. [rpm]	3000	1500	3000	1500

Table 2: Data set for piston pump design.