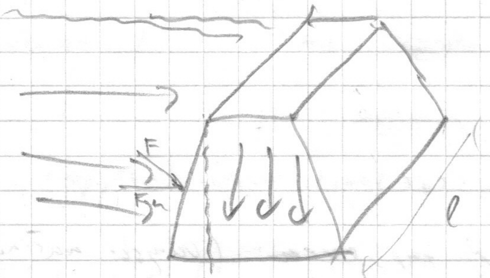
① Tri klisure

Duljina 2309 m

Visina 185 m

Dubina vode 175 m



$F_H = \rho g H_T \cdot A = 1000\, kg/m^3 \cdot 9.80665\, m/s^2 \cdot \frac{175}{2} m \cdot 2309 m \cdot 175 m =$

$= 3.47 \cdot 10^{11} N$

samo horizontalna (ne ukupna)

② Štednjak

1kg vode, snaga 500W = $\dot{P}$

→ tlak okoline, počela kipjeti
→ 15 s

$\eta_{st} = 1$

$h_{lat. isp.} = 2257.5313\, kJ/kg$

$dq = dh - v dp = dh$ ($dp = 0$)

$dH = h \cdot dm = (h'' - h') dm \;/dt$

$\frac{dH}{dt} = (h'' - h') \cdot \frac{dm}{dt}$

$\Rightarrow \frac{dm}{dt} = \frac{\dot{H} (= \dot{Q})}{h'' - h'} = \frac{500 W}{2258\, kJ/kg} = 0.22\, g/s$

$0.22 g : 1 s = 1000 g : x s$

$x = \frac{1000}{0.22} = 4545.45 s = 1.26 h$

③ Izentropa = povrativa adijabata (nema gubitaka u okolicu)

↓ $pV^{\varkappa} = konst$

$\varkappa = \frac{c_p}{c_v}$ Idealni plin ($\varkappa = 1.41$, $R = 287$ J/(kg K))

Poč. 1 bar, 20°C → kraj. 48 bar

$p_p V_p^{\varkappa} = p_k V_k^{\varkappa} \Rightarrow \frac{V_k}{V_p} = \left(\frac{p_p}{p_k}\right)^{\frac{1}{\varkappa}}$

$\frac{p_p V_p}{T_p} = \frac{p_k V_k}{T_k} \Rightarrow T_k = \frac{p_k V_k T_p}{p_p V_p}$

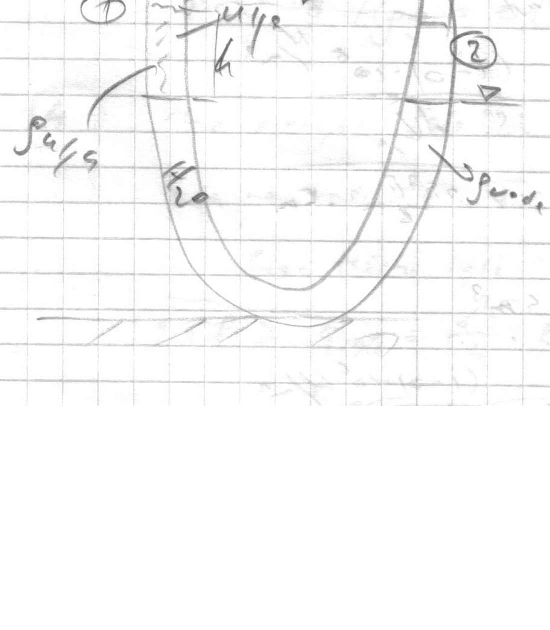
$T_k = 903.57\,K$; 0.0642

Sa = $\frac{p}{\rho^{\varkappa}} = konst \Rightarrow \frac{p_p}{\rho_p^{\varkappa}} = \frac{p_k}{\rho_k^{\varkappa}}$

$\rho_k = \left(\frac{p_k}{p_p}\right)^{\frac{1}{\varkappa}} \cdot \rho_p \Rightarrow \rho_p = \frac{p_p}{R_a T_p} = \frac{100\,k\,\frac{N}{m^2}}{0.287\,\frac{kNm}{kg\,K} \cdot 293.15\,K} = 1.19\,kg/m^3$

$\rho_k = \left(\frac{48\,bar}{1\,bar}\right)^{\frac{1}{1.41}} \cdot 1.19\,kg/m^3 = 18.53\,kg/m^3$

$T_k = \frac{p_k}{\rho_k \cdot R} = \frac{4800\,k\,\frac{N}{m^2}}{18.53\,kg/m^3 \cdot 0.287\,k\,\frac{Nm}{kg\,K}} = 902.5\,K$ (629.35°C)



$p_1 = \rho_{ulja} \cdot g \cdot h$

$p_2 = \rho_{vode} \cdot g \cdot h$

$p_1 = p_2$

$\rho_{ulja} \neq \rho_{vode} \Rightarrow$ Nije $h_v \neq h_{ulj.}$

Manometar

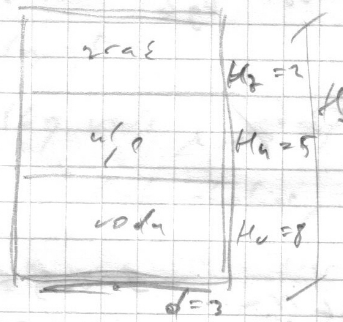
$$p_{a} + \rho_k \cdot g \cdot H_k - \rho_m \cdot g \cdot H_m = p_{ok}$$

$$\Rightarrow H_k = H_m \cdot \frac{\rho_m}{\rho_k}$$

ISPIT → 2-3 teoretska zadatka
→ zadaci ko iz DZ (jednostavno)

1 DZ - 2008

1. Celični valjak H_s, d (zatvoren)



Manometar → pretlak

Ukupan tlak = Manometar + dolica

V_{uk} = konst, zanemarujemo

Ubacujemo zrak do manometar 1.0 MPa

$$K = -\frac{dp}{dV} \cdot V \rightarrow \text{Volumni modul elast.}$$

$d \equiv \Delta + \Delta$

ulje: $$2050 \, N/m^2 = \frac{(1-0) \cdot 10^6 \, N/m^2}{\frac{dV_{ulja}}{\frac{3^2 \pi}{4} m^2 \cdot 5m}}$$

$$\Rightarrow dV_{ulja} = -17.24 m^3$$

Voda: $$2025 \, N/m^2 = \frac{(1-0) \cdot 10^6 \, N/m^2}{\frac{dV_{H_2O}}{\frac{3^2 \pi}{4} m^2 \cdot 8m}}$$

$$dV_{H_2O} = -27.25 m^3$$

$$dV_{uk} = dV_{H_2O} + dV_{ulja} = 44.49 m^3$$

$44.49\, m^3 = \frac{3^2\pi}{4}\, m^2 \cdot x\, m \Rightarrow x = 6.29\, m$

2. Voda pod nadtlakom 306 bara, čelični spremnik $1\, m^3$

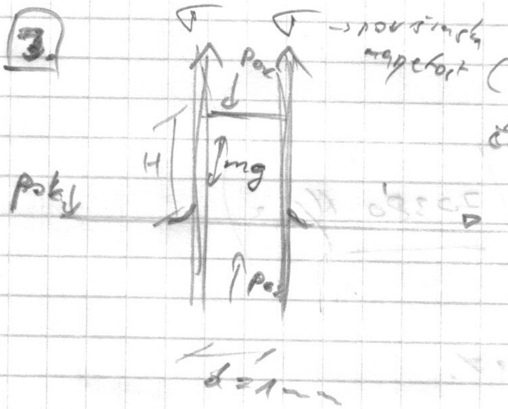
Raspršne li se spremnik koliko će biti volumen vode.

$\beta_p = \frac{1}{K} \Rightarrow K = \frac{1}{0.000476\, m^2/MN} = 2101\, \frac{MN}{m^2}$

koef. vol. stlačivosti

$K = -\frac{dp}{dV} \cdot V = -\frac{0-360\cdot 10^5\, N/m^2}{\frac{(V_2-1)\, m^3}{1\, m^3}} \Rightarrow V_2 = 1.017\, m^3$

3.



$\rho g V = \rho g d^2 \cdot H$

površ. napetost, uzgon, težina

$2\sigma d - d^2 H \rho g = 0\, (N) \Rightarrow H = 14.9\, mm$

4. Max promjer igle ???

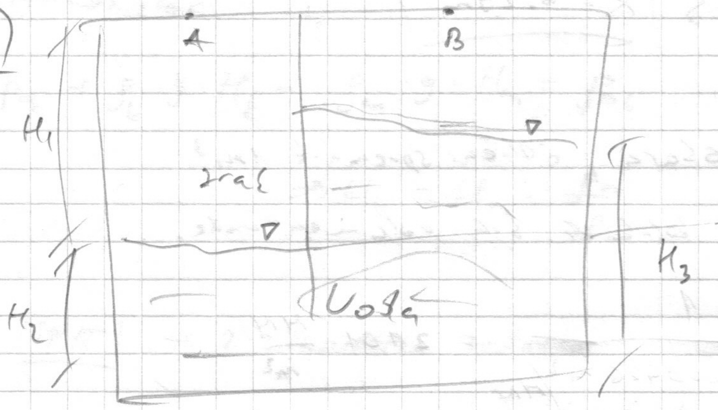
Igla na vodi → $\sigma = 0.0734\, N/m$

Spec težina igle $77.840\, N/m^3 \rightarrow \gamma_{čelik}$

$2\sigma l \geq G_{igle} = \frac{d^2\pi}{4} \cdot l \cdot \gamma_{čelik}$

$d_{max} = \sqrt{\frac{8\sigma}{\gamma_č \pi}} = 1.55\, mm$

5



Iz A u B

→ Ekvipot. ploha

(I)

$$p_A + \rho_z \cdot g \cdot H_1 + \rho_v \cdot g\,(H_3 - H_2) - \rho_z \cdot g\,(H_1 + H_2 - H_3) = p_B$$

Apsolutni $p_B = 70.404\ N/m^2$

(II) Bez težine zraka

$$p_A - \rho_v\, g\,(H_3 - H_2) = p_B$$

$$90000\ N/m^2 - 1000\ kg/m^3 \cdot 9.81\ m/s^2 \cdot 2m = 70380\ N/m^2$$

$$\text{Pogreška} = \frac{70404 - 70380}{70404} \cdot 100\% = 0.0341\%$$

6 Manometar na vert. cijevi

$p_A - p_B = ?$ $\rho_v = 1000\ kg/m^3$ $\rho_{Hg} = 13600\ kg/m^3$

$g = 9.81\ m/s^2$

$H = 0.6m$ $H_1 = 0.3m$ $H_2 = 1.5m$

Iz A u B   gore (minus), dole (plus)

$$p_A - \rho_v \cdot g\,(H_2 + H_1) - \rho_z \cdot g \cdot H + \rho_v \cdot g\,(H + H_1) = p_B$$

$$p_A - p_B = 88.878.6\ N/m^2$$