TLAK SILE

Fizika 1, knjiga: GIBANJE, SILA, SNOV
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leto: 1996

(list 1)

TLAK V TEKOČINI

1) Tlak teže tekočine:

Str. 153 / Primer: Za koliko se moramo spustiti v vodi, da se tlak poveča za $\Delta p = 1\,bar$?

($\varrho_{H_2O} = 1\,g/cm^3 = 10^3\,\frac{kg}{m^3}$)

$\Delta p = \varrho \cdot g \cdot h$

$$h = \frac{\Delta p}{\varrho \cdot g} = \frac{10^5\,\frac{N}{m^2}}{10^3\,\frac{kg}{m^3} \cdot 9{,}8\,\frac{m}{s^2}} = 10{,}2\,m$$

2) Zračni tlak:

Str. 157 / Primer: Gostota zraka na morski gladini je $1{,}3\,kg/m^3$. Koliko visok bi moral biti zračni plašč, da bi na morski gladini povzročal tlak 1,01 bar, če bi bil povsod tako gost kot ob morski gladini?

$p_0 = \varrho \cdot g \cdot h$

$$h = \frac{p_0}{\varrho \cdot g} = \frac{1{,}01 \cdot 10^5\,\frac{N}{m^2}}{1{,}3 \cdot 10^3\,\frac{kg}{m^3} \cdot 9{,}8\,\frac{m}{s^2}} = 7{,}9\,km$$

NALOGE:

(kuji, str. 158)

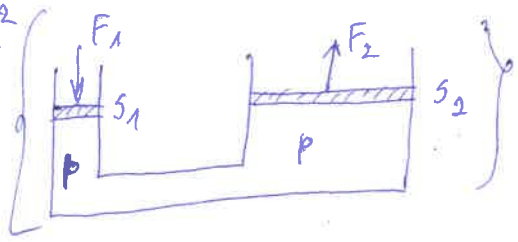
(#1) (#3) Hidravlična stiskalnica ima manjši bat s prerezom $S_1 = 5\,cm^2$ in večji bat s prerezom $S_2 = 1\,dm^2$. S kolikšno silo pritiska večji bat navzgor, če manjši bat pritiskamo s silo 50 N?

$S_1 = 5\,cm^2 = 5 \cdot 10^{-4}\,m^2$

$S_2 = 1\,m^2$

$F_1 = 50\,N$

$F_2 = ?$



$p = p$

$$\frac{F_1}{S_1} = \frac{F_2}{S_2}$$

$$F_2 = F_1 \cdot \frac{S_2}{S_1}$$

$$F_2 = 50\,N\,\frac{1\,m^2}{5 \cdot 10^{-4}\,m^2}$$

$$F_2 = 10^5\,N = 100\,kN$$

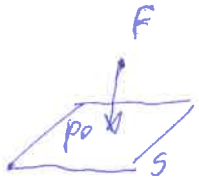
~~$F_2 = 100\,kN$~~

#1) S kolikšno silo pritiska zrak na vsak cm^2 človeške kože? Zračni tlak je okrog 1 bar.

$p_0 = 1\,bar = 10^5\,Pa$

$S = 1\,cm^2 = 10^{-4}\,m^2$

$F = ?$



$p = \frac{F}{S} \quad / \cdot S$

$F = p_0 \cdot S$

$F = 10^5\,Pa \cdot 10^{-4}\,m^2$

$F = 10\,N$

#2) Hidravlična zavora ima dva bata, enega s presekom $S_1 = 1\,cm^2$, drugega pa s $S_2 = 5\,cm^2$. S kolikšno silo F_1 moramo potiskati zavorni pedal, da bat S_2 pritiska na zavoro s silo $F_2 = 500\,N$?

$S_1 = 1\,cm^2$

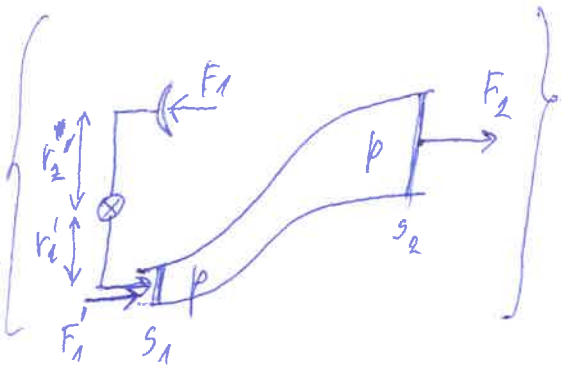
$S_2 = 5\,cm^2$

$r_1' = 3\,cm$

$r_2' = 15\,cm$

$F_2 = 500\,N$

$F_1 = ?$



Tlaka sta enaka:

$p = p$

$\frac{F_1'}{S_1} = \frac{F_2}{S_2}$

$F_1' = F_2 \cdot \frac{S_1}{S_2}$

$F_1' = 500\,N \cdot \frac{1}{5}$

$F_1' = 100\,N$

Navora sta enaka:

$M_1 = M_1'$

~~$F_1 r_2 = F_1' r_1'$~~

$M_1 = M_1'$

$F_1 \cdot r_2' = F_1' \cdot r_1'$

$F_1 = F_1' \cdot \frac{r_1'}{r_2'}$

$F_1 = 100\,N \cdot \frac{3}{15}$

$F_1 = 20\,N$

#4) Plastično cev z notranjim presekom $1\,cm^2$ napolnimo z vodo in jo postavimo pokonci. Zgornji konec cevi je zaprt, ob spodnje ustje pa prislonimo ploščico z maso 200 g. Kako visoka je lahko cev, da ploščica, ki spodaj zadržuje vodo, ne odpade. Zunanji zračni tlak je 1 bar.

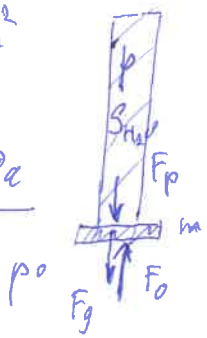
$S_1 = 1\,cm^2 = 10^{-4}\,m^2$

$m = 200\,g = 0{,}2\,kg$

$p_0 = 1\,bar = 10^5\,Pa$

$h = ?$

$\rho_{H_2O} = 10^3 \frac{kg}{m^3}$



$\Sigma \vec{F} = \phi$

$\vec{F}_g + \vec{F}_p + \vec{F}_0 = \phi$

$F_0 = F_g + F_p$

$F_p = F_0 - F_g$

$S \cdot p = S \cdot p_0 - m \cdot g$

$S \cdot (\rho \cdot g \cdot h) = S \cdot p_0 - m \cdot g \quad / \cdot \frac{1}{S \cdot \rho \cdot g}$

$h = \frac{S p_0 - m \cdot g}{S \cdot \rho \cdot g}$

$h = \frac{(10^{-4}\,m^2 \cdot 10^5\,Pa) - (0{,}2\,kg \cdot 9{,}8\,\frac{m}{s^2})}{(10^{-4}\,m^2 \cdot 10^3\,\frac{kg}{m^3} \cdot 9{,}8\,\frac{m}{s^2})}$

$h = 8{,}2\,m$

TLAK V TEKOČINI

knjiga: GIBANJE, SILA, SNOV (list 2)

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#5) Koliksen je tlak zraka v zračnem mehurčku, ki je na globini 20 m pod morsko gladino? Zračni tlak na gladini je 1 bar.

$h = 20\,m$

$p_0 = 1\,bar = 10^5\,Pa$

$\varrho = 10^3\,kg/m^3$

$p = ?$

$p = p_0 + \varrho \cdot g \cdot h$

$p = 10^5\,Pa + (10^3\,\frac{kg}{m^3} \cdot 9{,}8\,\frac{m}{s^2} \cdot 20\,m)$

$p = 10^5\,Pa + 1{,}96 \cdot 10^5\,Pa$

$p = 2{,}96 \cdot 10^5\,Pa$

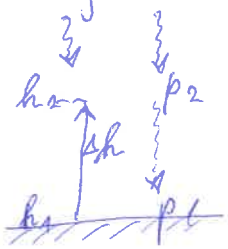
$p \doteq 3\,bar$

#6) Približno za koliko se zračni tlak zmanjša, če se dvignemo za 10 m? Predpostavljamo enakomerno gostoto zraka 1,2 kg/m³.

$h = 10\,m$

$\varrho_z = 1{,}2\,\frac{kg}{m^3}$

$\Delta p = ?$



$\Delta p = p_2 - p_1$

$\Delta p = \varrho_z \cdot g \cdot h_2 - \varrho_z \cdot g \cdot h_1$

$\Delta p = \varrho_z \cdot g \cdot (h_2 - h_1)$

$\Delta p = \varrho_z \cdot g \cdot \Delta h$

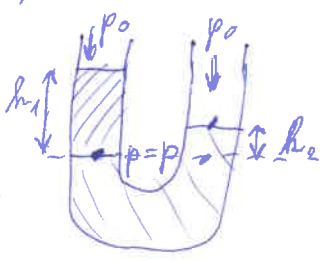
$\Delta p = 1{,}2\,kg/m^3 \cdot 9{,}8\,\frac{m}{s^2} \cdot 10\,m$

$\Delta p = 117{,}6\,Pa$

#7) V cel U z odprtima krakoma natočimo nekaj živega srebra. V en krak dolijemo 6,3 cm dolg stolpec neke druge kapljevine. Koliksna je gostota dolite kapljevine, če je gladina živega srebra v enem kraku za 1,2 cm višje kot v drugem? Gostota živega srebra je 13,6 g/cm³.

krak 1: $h_1 = 6{,}3\,cm$, $\varrho_1 = ?$

krak 2 (Hg): $\varrho_2 = 13{,}6\,g/cm^3$, $h_2 = 1{,}2\,cm$



$p = p_0$

$p_0 + \varrho_1 \cdot g \cdot h_1 = p_0 + \varrho_2 \cdot g \cdot h_2$

$\varrho_1 = \varrho_2 \cdot \frac{h_2}{h_1}$

$\varrho_1 = 13{,}6\,\frac{g}{cm^3} \cdot \frac{1{,}2\,cm}{6{,}3\,cm}$

$\varrho_1 = 2{,}6\,g/cm^3$

#8) Okrogla posoda

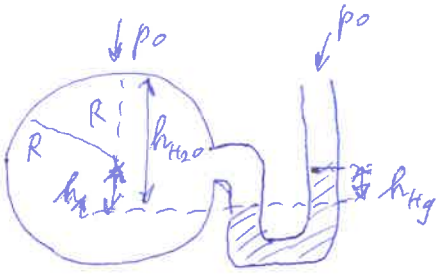
$h_1 = 26\,cm = 0{,}26\,m$

$h_{Hg} = 20\,cm = 0{,}2\,m$

$\varrho_{H_2O} = 10^3 \frac{kg}{m^3}$

$\varrho_{Hg} = 13{,}6 \cdot 10^3 \frac{kg}{m^3}$

$R = ?$



$h_{H_2O} = R + h_1$

$R = h_{H_2O} - h_1$

$R = (2{,}72 - 0{,}26)\,m$

$R = 2{,}46\,m$

$p = p$

$p_0 + \varrho_{H_2O} \cdot g \cdot h_{H_2O} = p_0 + \varrho_{Hg} \cdot g \cdot h_{Hg}$

$\varrho_{H_2O} \cdot h_{H_2O} = \varrho_{Hg} \cdot h_{Hg}$

$h_{H_2O} = h_{Hg} \cdot \frac{\varrho_{Hg}}{\varrho_{H_2O}}$

$h_{H_2O} = 0{,}2\,m \cdot \frac{13{,}6 \cdot 10^3}{10^3}$

$h_{H_2O} = 2{,}72\,m$

#9)

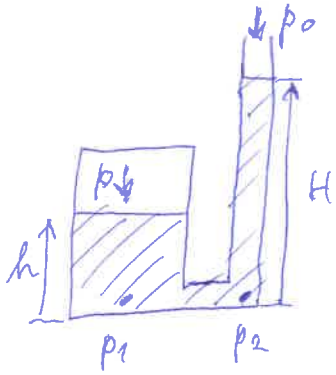
$h = 20\,cm = 0{,}2\,m$

$H = 1\,m$

$p_0 = 1\,bar = 10^5\,Pa$

$\varrho = 10^3 \frac{kg}{m^3}$

$p = ?$



$p_1 = p_2$

$p + \varrho \cdot g \cdot h = p_0 + \varrho \cdot g \cdot H$

$p = p_0 + \varrho \cdot g \cdot H - \varrho \cdot g \cdot h$

$p = p_0 + \varrho \cdot g \cdot (H - h)$

$p = 10^5\,Pa + (10^3 \frac{kg}{m^3} \cdot 9{,}8 \frac{m}{s^2} \cdot (1 - 0{,}2)\,m$

$p = 1 \cdot 10^5\,Pa + 7{,}8 \cdot 10^3\,Pa$

$p = 107{,}8 \cdot 10^3\,Pa$

$p = 1{,}078\,bar$

#10)

$\Delta p = 1{,}3\,mbar = 130\,Pa$

$\varrho_z = 1{,}2\,kg/m^3$

$\Delta h = ?$

$\Delta p = \varrho_z \cdot g \cdot \Delta h$

$\Delta h = \frac{\Delta p}{\varrho_z \cdot g}$

$\Delta h = \frac{130\,Pa}{1{,}2\,kg/m^3 \cdot 9{,}8 \frac{m}{s^2}}$

$\Delta h = 11\,m$