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Biomedical Engineering
Assignment

1. Length = 20
V at smaller end = 5m/s
V at lower end = 2m/s
P at smaller end = 2.5m
loss of head = $\frac{0.35(5-2)^2}{2\times9.81} = 0.16$

$$\frac{P_1}{w} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{w} + \frac{V_2^2}{2g} + z_2 + hf$$

$$\frac{P_1}{w} + \frac{V_1^2 - V_2^2}{2g} + z_1 - z_2 - hf = \frac{P_2}{w}$$

$$2.5 + \frac{(5^2-2^2)}{2\times9.81} + 2.0 - 0.16 = \frac{P_2}{w} \quad ; \quad 2.5 + (0.97 + 2.0) - 0.16 = \frac{P_2}{w}$$

$$5.416\,bar = \frac{P_2}{w}$$

2. $d_1 = 20cm$ $a_1 = \frac{\pi \times (20)^2}{4} = 314.16\,cm^2$
$d_2 = 10cm$ $a_2 = \frac{\pi (10^2)}{4} = 78.44cm^2$

$P_1 = 17.688\,N/cm^2 = 17.658\times10^4\,N/m^2$

for water ; $\frac{P_1}{Pg} = \frac{17.658\times10^4}{1.81\times1000} = 18m$ of water

$\frac{P_2}{Pg} = -36cm\,Hg = 0.30m = -0.30\times13.62 = -4.08m$ of water

Diff head ; $h = \frac{P_1}{Pg} - \frac{P_2}{Pg} = 18 - (-4.08)$
$= 18 + 4.08 = 22.08m$ of water

$$\frac{a_1 a_2}{\sqrt{a_1^2 - a_2^2}} \times \sqrt{2gh}$$

0.98×3.14

$$0.98 \times \frac{314.16 \times 78.54}{\sqrt{(314.16)^2 - (78.54)^2}} \times \sqrt{2 \times 9.81 \times 2208}$$

$$= \frac{50328837.21}{304} \times 165555\ cm^3/s = 165.56\ cls$$

3. $a_2 = \frac{\pi d^2}{4} = 314.16 cm^2$

$d_2 = 10 \quad d_1 = 20$

$a_1 = \frac{\pi d^2}{4} = 78.74 cm^2$

Sp gr oil $= 0.9$

Reading of diff manometer $= 50cm$ of mercury

Diff head; $h = x\left[\frac{S_g}{S_o} - 1\right] = 50\left[\frac{13.6}{0.9} - 1\right]$

$= 50 \times 14.11 = 705.5$ cm of oil

$Cd = 0.64$

rate of flow

$$Q = Cd \frac{a - a_1}{\sqrt{a_1^2 - a_0^2}} \times \sqrt{2gh}$$

$$= 0.64 \times \frac{314.16 \times 78.74}{\sqrt{(78.74)^2 - (314.16)^2}} \times \sqrt{2 \times 981 \times 705.5}$$

$= 61243.77 = 61.2\ l/s$

4. Diff of mercury level, V_2?

$x = 170mm = 0.17m$

Sg of mercury $= 13.6$

Sg of $S_n = 1.026$

$h = x\left[\frac{S_g}{S_o} - 1\right]$

$0.17\left[\frac{13.6}{1.026} - 1\right] = 2.0834$

$V = \sqrt{2gh} = \sqrt{2 \times 9.81 \times 2.0837}$

$= 6.373 \text{ m/s}$

To change -10 km/h

$= \frac{6.373 \times 60 \times 60}{1000}$

$= 23.01 \text{ km/hr}$