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18/ENG02/045
COMPUTER ENGINEERING

1) $l = 2.0m$

$V_1 = 5m/s$ $\quad V_2 = 2m/s$

$$\frac{P_1}{w} = 2.5m$$

$$hl = 0.35\frac{(V_1 - V_2)^2}{2g}$$

substitute values for hl

$$hl = \frac{0.35(5-2)^2}{2 \times 9.81} = 0.16.$$

Applying Bernoulli's theor

$$\left(\frac{P_1}{w} - \frac{P_2}{w}\right) + \left(\frac{V_1^2}{2g} - \frac{V_2^2}{2g}\right) + (Z_1 - Z_2) = hl$$

$$\left(2.5 - \frac{P_2}{w}\right) + \left(\frac{5^2}{2\times9.81} - \frac{2^2}{2\times9.81}\right) + (2) = 0.16$$

$$2.5 - \frac{P_2}{w} + (1.274 - 0.204) + 2 = 0.16$$

$$2.5 - \frac{P_2}{w} = 0.16 - 2 - 1.07$$

$$\frac{P_2}{w} = -2.91 + 2.5$$

$$\frac{P_2}{w} = 5.41m$$

2) $d_1 = 20cm$ $d_2 = 10cm$ $P_1 = 17.658\ N/cm^2$

$P_2 = -30cm\ Hg$ $Cd = 0.98$ $A = \pi d^2/4$

$A_1 = \frac{\pi \times 0.2^2}{4}$ $A_2 = \frac{\pi \times 0.1^2}{4}$ $\frac{P_1}{\omega} = \frac{176.58}{9.81}$

$= 0.0314$ $= 0.00785$ $= 18$

$P_2 = -0.3 m Hg \times 13.6$ $h = \frac{P_1}{\omega} - \frac{P_2}{\omega}$

$= -4.08$ $= 18 - (-4.08) = 22.08$

$Q = Cd = \frac{A_1 A_2}{\sqrt{A_1^2 - A_2^2}} \times \sqrt{2gh}$

$= \frac{0.98 \times 0.0314 \times 0.00785}{\sqrt{0.0314^2 - 0.00785^2}} \times \sqrt{2 \times 9.81 \times 22.08}$

$Q = 0.165 m^3/s = 165.5$ Lit/s

3) $d_0 = 15cm$ $d_1 = 30cm$

$y = 500 mm\ Hg$

$C.d = 0.64$

$A = \frac{\pi d^2}{4}$ $A_0 = \frac{\pi \times 0.15^2}{4}$ $A_1 = \frac{\pi \times 0.3^2}{4}$ $h = 50\left(\frac{13.6}{0.7} - 1\right)$

$Q = \frac{Cd \times A_0 \times A_1}{\sqrt{A_1^2 - A_0^2}} = \frac{0.64 \times 0.018 \times 0.071}{\sqrt{0.071^2 - 0.018^2}}$ $= 705.6$

$= \frac{0.64 \times 0.018 \times 0.071}{\sqrt{0.071^2 - 0.018^2}} \times \sqrt{2 \times 9.81 \times 705.6}$

$= 136.8$ Lit/s

i) speed ~~rate~~ $= \sqrt{2gh}$

$h = y\left(\frac{55}{51} - 1\right) = 0.4\left(\frac{13.6}{1.026} - 1\right)$ $h = 2.053$ m

$\therefore V = \sqrt{2 \times 9.81 \times 2.053}$

$= 6.39$ m/s

ii) $VE = \frac{\text{actual flow rate}}{\text{ideal flow rate}} \times 100$

Ideal fr = nominal speed × displacement

$= \frac{10 cm^3}{rev} \times \frac{1700 rev}{min} \times 1700 cm^3/min = 2.83 \times 10^{-4} m^3/s$

actual flow rate = ~~0.05 m³/min~~ $0.05 m^3/min = 8.33 \times 10^{-4} m^3/s$

$V.E = \frac{8.33 \times 10^{-4}}{2.83 \times 10^{-4}} \times 100$

$= 2.93 \times 100$

$= 293\%$

ii) fluid power = ∂·P

$= 8.3 \times 10^{-4} \times (15 \cdot 10^5) = 1249.5$ watts

iii) shaft power = ~~∂·P~~ T·ω

$= (15 \times (2\pi N)$

$= 15 \times 2 \times \pi \times \frac{2700}{60} = 2867$ watts