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1) $l_1 = 2.0m$

The Velocity flow at $V_1 = 5m/s$

$V_2 = 2m/s$

let the pressure head at the smaller end $p_2 = 2.5m$ of liquid

let the loss of head $H_L = \frac{0.35(v_1-v_2)^2}{2g}$

$= \frac{0.25(3.2)^2}{2 \times 9.81}$

$= 0.161m$

let the pressure head at the Unit end

$\frac{P_2}{\rho g} = \frac{V^2}{2g} \cdot \frac{P_2}{\rho g} = \frac{V^2}{2g} + Z_2 + h_L$

$5 + \frac{5^2}{2 \times 9.81} + 2.0 \cdot P_2 + \frac{2^2}{2 \times 9.81}$ to to +0.161

$P_2 = 2.5 + \frac{25}{19.63} + 2 = \left(\frac{4}{19.62} + 0.161\right) = P_2$

$3.994 - 0.365 = P_2$

$P_2 = 3.499m$

(2)

$P_1 = 20cm$

$P_2 = 14cm$

$A = \frac{\pi r^2}{4} = \frac{\pi(26)}{4} = 314.16cm^2$

$A_2 = \frac{\pi(10)}{4} = 73.34cm^2$

Density of $\rho = 1000 kg/m^3$

Pressure of inlet $= 17.608 m/cm^3$

$= 17.658 cm^2 m/m$

$P_1/\rho g = 19.658 \times 10^4$

$\frac{P_2}{\rho g} = -30cm$ of mercury, $S_g \cdot g = 13.6$

$\frac{\rho}{\rho g} = -30 \times 10^{-2} m$ of mercury $\times 13.6$

$= -4.08m$

Differential head $= H = \frac{P_1}{\rho g} - \frac{P_2}{\rho g}$

$18 - (-4.08)$

$18 + 4.08 = 22.08m \times 100$

$h = 22.08cm$

$Q = \frac{C_d A_1 \sqrt{2gh} \cdot A_1 - A_2}{\sqrt{A_1^2 - A_2^2}}$

$= \frac{0.98 \times \sqrt{2 \cdot 981} \times 2208 \times 314.16 \times 90.54}{\sqrt{314.16^2 - 18.54^2}}$

$= 165455.3 cm^2/s$

$= \frac{165455.3}{1000} = 165.455 m^3/sec$

(3)

$d = 30$

$A_1 = \frac{\pi d^2}{4} \cdot \frac{\pi(30)}{4}$

$= 1106.86 cm^2$

$d^2 = 15cm$

$A_2 = \frac{\pi d^2}{4} \cdot \frac{\pi(15)}{4} = 176.72$

$S_o = 0.9$
Specific gravity of mercury = 13.6
Differential manometer reading $x = 30cm$ of mercury
$Cd = 0.64$

$h = x\left(\frac{S_g}{S_o} - 1\right)$

$h = 38\left(\frac{13.6}{0.9} - 1\right)$

$h = 105.56$ cm of oil

The rate of flow of oil Q =

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

$Q = 0.24\sqrt{2 \times 9.81 \times 205.56} \times \frac{906.56 \times 126.72}{\sqrt{(606.86)^2 - (176.72)}}$

$Q = 137443.29 cm^3/s$

$Q = \frac{137443.29}{1000} = 137.446 l/s$

(4)

$x = 116cm = 190cm = 0.19m$
$S_g = 13.16$
$S_{x} = 102.6$
Speed $U = ?$

$U = \sqrt{2gh}$

$h = x\left[\frac{S_g}{S_x} - 1\right] = 0.12$

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

$= 2.0634m$

$V = \sqrt{2 \times 9.81 \times 2.0834}$
$= 6.393 m/s$
In Kg/hr
$q = \frac{6.393 \times 60^2}{1000}$
$= 23.61 Km/hr$

(5)

$Q = 0.05 m^3/min = 50 dm^3/m$
$P_s = 15 bar = 15 \times 10^5 N/m$
Speed = 170m
$T = 15Nm$ $N_g = 10cm^3/km$

Volumetric efficiency
$\frac{\text{Actual flow rate}}{\text{Ideal flow rate}}$

Ideal flow rate = decimal flow rate × Speed
$10 cm^3/km \times 1700 km/m$
$= 1700 cm^3/min$

Ideal flow rate = $0.03m^2/min$

Volumetric efficiency
$= \frac{0.05}{0.67} = 2.94\%$

Fluid power = $P \times Q$
$P = 1.3 \times 10^3 N/m^2$
$q = 0.05m^3/m = 0.05/60$
$= 8.33 \times 10^{-4} m^2/s$

Fluid power $= 1.5 \times 10^3 \times 8.33 \times 10^{-4}$
$= 1.249.3$ watts

In Shaft power $\frac{2\pi NT}{60}$

$\frac{2\pi \times 1500 \times 15}{60}$

Sh
Ov
>
1 Ov

Shaft power $= 2670.35$ watt

Overall efficiency $= \frac{\text{fluid power}}{\text{shaft power}}$

$= \frac{1249.5}{2670.33}$

$= 0.468$

Overall efficiency $= 0.468 \times 100$

$= 46.8\%$