

Fluid Mechanics

① $V_1 = 5 \text{ m/s}$ $V_2 = 2 \text{ m/s}$

Pressure smaller end = 2.5 m

$$M_f = \frac{0.35 (v_1^2 - v_2^2)}{2g} \quad L = 2.0 \text{ m}$$

Pressure lower end =

$$h = z_1 - z_2 = 2 \text{ m}$$

$$\frac{P_1}{\rho} + \frac{v_1^2}{2g} + z_1 = \frac{P_2}{\rho} + \frac{v_2^2}{2g} + z_2 + h_f$$

$$\frac{P_2}{\rho} = \frac{P_1}{\rho} + \frac{1}{2g} (v_1^2 - v_2^2) + (z_1 - z_2) - h_f$$

$$= 2.5 + \frac{5^2 - 2^2}{2 \times 9.81} + 2 - \frac{0.35 (5^2 - 2^2)}{2 \times 9.81}$$

$$= 2.5 + 1.07 + 2 - 0.16055$$

$$P_2 = 5.409 \text{ bar}$$

Pressure at lower end is 5.409 bar

② inlet diameter = 200 mm

Throat diameter = 100 mm

Pressure at inlet =

$$P_1 = 12.658 \text{ m}$$

$g = 300 \text{ m/s}$ of mercury

$$C_d = 0.98$$

$$A_1 = \frac{\pi d^2}{4} = \frac{(20)^2 \times 3.14}{4} = 0.0314 \text{ m}^2$$

$$A_2 = \frac{\pi d^2}{4} = \frac{(10)^2 \times 3.14}{4} = 7.853 \times 10^{-2}$$

$g = 300 \text{ cm}$ (0.3 m of mercury)

$$P_1 = 12.658$$

$$= \frac{12.658}{1000} = 1.2658 \times 10^{-3} \text{ N/m}^2$$

$$\frac{P_1}{\rho} = \frac{1.2658 \times 10^{-3}}{9.81} = 1.28 \times 10^{-4} \text{ m}$$

$$\frac{P_2}{\rho} = 0.3 \times 13.6 = 4.08 \text{ of } H_2O$$

$$h = \frac{P_1}{\rho} - \frac{P_2}{\rho} = 1.28 \times 10^{-4} - (4.08)$$

$$h = 4.08018 \text{ m}$$

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

$$Q = 0.98 \times \frac{0.0314 \times 7.853 \times 10^{-3}}{\sqrt{(0.0314)^2 - (7.853 \times 10^{-3})^2}}$$

$$\times \sqrt{2 \times 9.81 \times 4.08018}$$

$$Q = \frac{0.000241}{0.0304} \times 8.947$$

$$Q = 0.0709 \text{ m}^3/\text{s}$$

③ $D_1 = 15 \text{ cm}$ $D_2 = 30 \text{ cm}$

Speed of mercury = 0.5 m $Q = ?$

$$S.G. = 0.9 \quad C_d = 0.64$$

$$A_1 = \frac{\pi d^2}{4} = \frac{(15)^2 \times 3.14}{4} = 0.0176 \text{ m}^2$$

$$A_2 = \frac{\pi d^2}{4} = \frac{(30)^2 \times 3.14}{4} = 0.0706 \text{ m}^2$$

$$h = 2 \left[\frac{136}{0.9} - 1 \right]$$

$$h = 0.5 \left[\frac{136}{0.9} - 1 \right]$$

$$= 2.05 \text{ m of } H_2O$$

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

$$Q = \frac{0.64 \times 0.0176 \times 0.0070}{\sqrt{(0.0176)^2 - (0.0070)^2}} \sqrt{2 \times 9.81 \times 7.05}$$

$$Q = \frac{4.35 \times 10^{-3}}{40.12}$$

$$Q = 2.33 \times 10^{-3} \text{ m}^3/\text{s}$$

④ $A \times v = 15 \text{ m}$

170 mm of Mercury (0.17 m)

SG of Mercury (13.6)

SG of sea water = 1.026 $v = ?$

$$h = \left(\frac{S_2}{S_1} - 1 \right)$$

$$h = 0.17 \left(\frac{13.6}{1.026} - 1 \right)$$

$$h = 2.083 \text{ m}$$

$$v = \sqrt{2gh}$$

$$v = \sqrt{2 \times 9.81 \times 2.083}$$

$$v = 6.39 \text{ m/s}$$

⑤ $0.05 \text{ m}^3/\text{min}$

15 bar

1700 RPM

$100 \text{ m}^3/\text{PV}$

15 N/mm