To Observe the Decrease in Pressure with Increase in Velocity of a Fluid

Aim

To observe the decrease in pressure with increase in velocity of a fluid.

Apparatus

A wide tube and a narrow tube, (or venturimetre), with two vertical tubes, vernier callipers, tap water, metre scale etc.

Short description

The one end of wide tube (pipe) is connected to the narrow tube (pipe) tightly so that the water must not leakage. The free end of wide pipe is connected to tap water. The pipes are placed horizontally on the table in such a way that both vertical tubes (capilaries) remain vertical in a horizontal line as shown in diagram.

Theory

The venturimetre is a gauge used to measure the flow rate of a fluid when the motion of fluid is steady. It working is based on Bernoulli's theorem. For horizontal flow,

$$P + \frac{1}{2}\rho V^2 = \text{Constant} \quad \ldots(1)$$

The equation of continuity

$$av = \text{constant} \quad \ldots(2)$$

$$P = \rho g h \quad \ldots(3)$$

where, P is the static pressure.

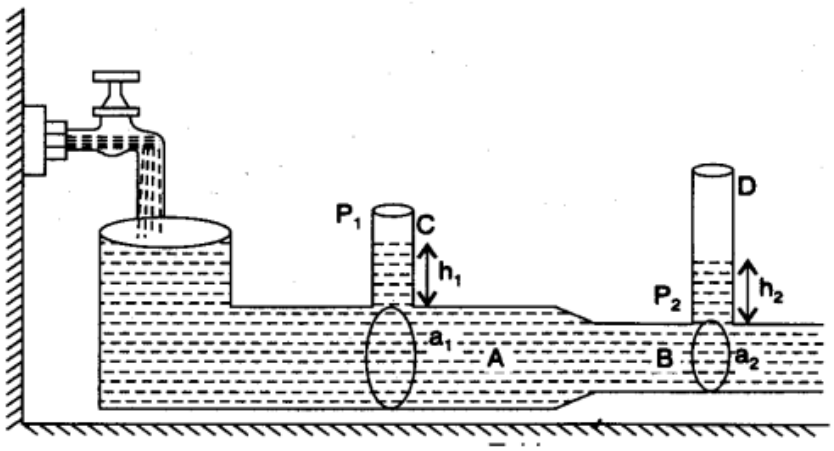
ρ is the density of fluid (water)

V is the velocity of fluid

a is the area of cross sectional pipe.

There is a low pressure in a region where velocity of fluid is high and vice-versa. The velocity of fluid is high at a cross-section of narrow area and vice versa.

Diagram



Procedure

1. Measure the internal diameters of both the horizontal pipes A and B by using vernier callipers at least two times to determine the area of cross-section of pipes.
2. Join the pipes A and B in such a way that there must not be leakage of water at the junction.
3. Placed two pipes A and B horizontally on the table so that tubes C and B remains vertical and parallel to each others.
4. Open the water tap at slow rate so that flow of water remain steady in the pipes A and B.
5. Measure the heights of water in tubes C and B by the metre scale to calculate the pressure.
6. Increase the rate of tap water in pipes A and B for two more reading and repeat step 5.

Observations

1. Least count of metre scale = ... cm
2. Mean diameters of pipes A and B

   Area of pipe A, $a_1 = \pi r_1^2 = \frac{\pi d_1^2}{4} = \ldots$

   Area of pipe B, $a_2 = \pi r_2^2 = \frac{\pi d_2^2}{4} = \ldots$

3. Velocities of water in pipe A = V_1

   Velocity of water in pipe B = V_2

   $$a_1 V_1 = a_2 V_2$$

   $$\frac{V_1}{V_2} = \frac{a_2}{a_1}$$

4. Density of water $\rho = 1\ g\ cm^{-3}$
5. Acceleration due to gravity $g = 980\ cm^2/s$.

S. No.	Pipe A		Pipe B	
	V_1 (cm/s)	h_1 (cm)	V_2 (cm/s)	h_2 (cm)
1.				
2.				
3.				

Calculations

1. Calculate the ratio of velocities of water in pipes.
2. Calculate the pressure of water in tubes C and D by using P = ρgh.

Conclusion

The pressure of fluid (water) decreases (height of water decreasing). When the velocity of water increases at narrow cross-section and vice-versa.

Precaution

1. The flow of water in pipes A and B should be steady.
2. The water should not be overflow and leakage.
3. The pipes A and B must be horizontal.
4. The tubes C and D should be parallel and vertical to each other.

Sources of error

1. The flow of water in pipes A and B may not be steady.
2. The water is not a ideal fluid.
3. The pipes may not be perfectly horizontal.