Experiment- 3

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Flow rate measurement using an orifice

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1. Aim:

- To determine the Constant of Proportionality between the volume flow rate and the square root difference in pressure across the orifice.
- Measurement of flow rate using orifice for different diameter.

2. Apparatus:

- The orifice meter
- Digital manometer
- Anemometer and manometer
- Orifice plates

3. Equations:

- $$patm = \frac{\rho v^2}{2} \tag{1}$$

  p atm = atmospheric pressure, p = static pressure port, rho = density of air

- $$V = \alpha \epsilon A_d \sqrt{\frac{2\Delta p}{\rho}} \tag{2}$$

  $\alpha = flowparameter = 0.64, \epsilon = 0.991, A_d = Areaoftheorifice, \Delta p = pressurediferenceacrossori$

Figure 1: An orifice meter

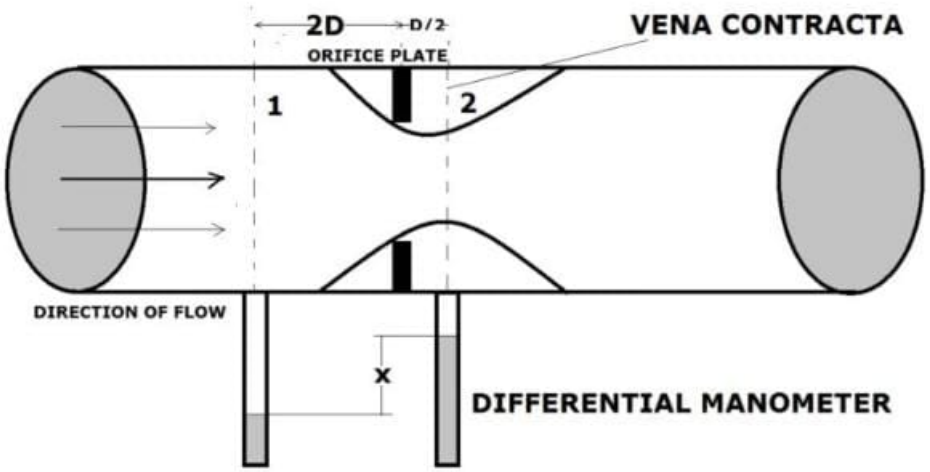

Figure 2: Different parts of an orifice meter

4. Theory:

An orifice meter is a device that can measure the flow rate in a pipe by using an orifice plate.It can measure volumetric flow rates ,this measuring device operates on the same principle as venturi meter which is Bernoulli's principle and the principle states that the pressure and velocity of the fluid are related,like if the velocity increases then the pressure will decrease and vice versa.

5. Procedure:

- First fix the desired orifice in the orifice meter.
- Gradually increase the speed of the wind flowing inside after starting the machine
- Take readings when flow stabilises.
- Repeat the process by using orifice meters of different diameters.

6. Results:

S.No.	Pressure difference(Pa)	Velocity of air(m/s)	$\sqrt{\delta p}$
1	20	0.2	0.447
2	30	0.4	0.632
3	40	0.8	0.894
4	50	1.2	1.095
5	60	1.9	1.378

Table 1: Data obtained for 32mm diameter orifice

S.No.	Pressure difference(Pa)	Velocity of air(m/s)	$\sqrt{\delta p}$
1	5	1.5	1.225
2	10	7.9	2.811
3	12	11.4	3.376
4	15	18.3	4.278
5	18	28.8	5.366

Table 2: Data obtained for 12mm diameter orifice

7. Graph:

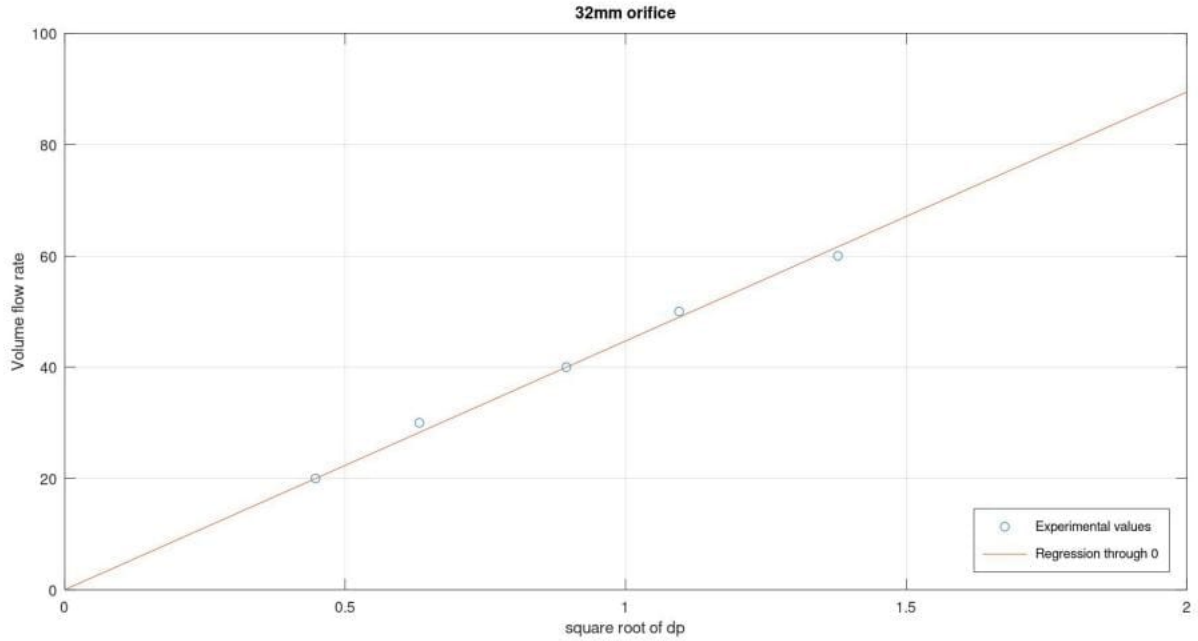

Figure 3: 32 mm diameter orifice

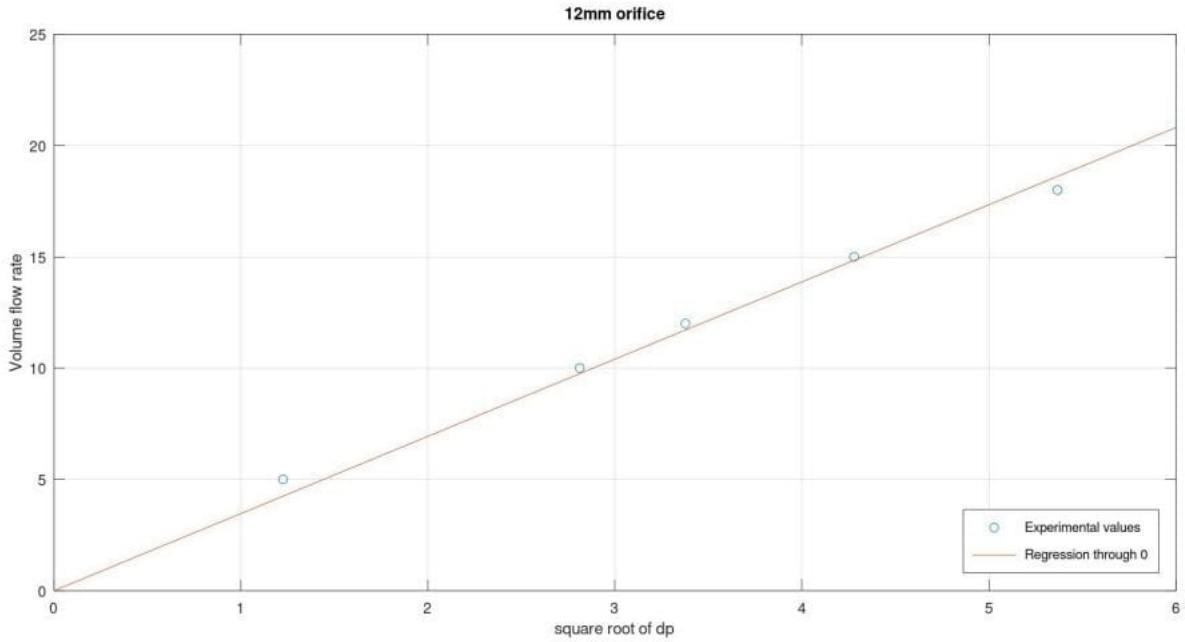

Figure 4: 12 mm diameter orifice

8. Sources of error:

- error in the manometer and the multimeter.
- orifice plate not being fixed correctly
- small changes in pressure during the reading may cause an error.

9. Conclusion:

- As the Pressure difference across the orifice increases the velocity of the fluid increases vice-versa.
- Thus,the volume flow rate is proportional to the square root of pressure difference across the orifice.