Viva Questions:

1. Who demonstrated the principle of Venturi meter first?

A. The Principle of Venturi meter was first demonstrated in 1797 by Italian Physicist G.B. Venturi (1746 - 1822).

2. Who applied Venturi meter principle?

A. C. Herschel (1842-1930) applied Venturi meter principle in 1887.

3. What is the basic principle of venturi meter?

A. The basic principle on which a venturi meter works is that by reducing the cross-sectional area of the flow passage, a pressure difference is created and the measurement of the pressure difference enables the determination of the discharge through the pipe.

4. What are the parts of Venturi meter?

A. a. An inlet section followed by a convergent cone
b. A Cylindrical throat

c. A gradually divergent cone

5. What is convergent cone?

A. It is a short pipe which tapers from the original size of the pipe to that of the throat of the venturi meter

6. What is throat of Venturi meter?

A. The throat of the Venturi meter is a short parallel sided tube having its cross-sectional area smaller than that of the pipe.

7. What is divergent cone?

A. It is a gradually diverging pipe with its cross-sectional area increasing from that of the throat to the original size of the pipe.

8. Where pressure taps are provided?

A. At the inlet section and throat.

9. What is the total included angle of convergent cone of Venturi meter?

A. $21^0 \pm 1^0$

10. What is the length of the convergent cone?
A. 2.7 (D-d)

D = Diameter of the inlet section

d = Diameter of the throat

11. What is the included angle of divergent cone?
A. 5^0 to 15^0 (preferably about 6^0)

12. Which part is smaller, convergent cone or divergent cone? Why?
A. Convergent cone is smaller. To avoid the possibility of flow separation and the consequent energy loss, the divergent cone of the venturi meter is made longer with a gradual divergence.

13. Where separation of flow occurs?
A. In Divergent cone of Venturi meter

14. Which portion is not used for discharge measurement?
A. Divergent cone

15. Which cross-sectional area is smaller than cross sectional area of inlet section?
A. Throat

16. Where velocity of flow greater?
A. Throat

17. Where pressure is low in Venturi meter?
A. Throat

18. How pressure difference is determined?
A. By connecting a differential manometer

19. Between which sections the pressure difference can be determined?
A. Inlet section and Throat

20. What we should do for getting greater accuracy in the measurement of the pressure difference?

A. The cross sectional area of the throat should be reduced so that the pressure at throat is very much reduced.

21. What is cavitation?

A. The formation of the vapour and air pockets in the liquid ultimately results in a phenomenon called Cavitation.

22. What is value of diameter of throat?

A. The diameter of throat may very from 1/3 to ¾ of the pipe diameter and more commonly the diameter of the throat is kept equal to ½ of the pipe diameter.

23. What should be done to avoid cavitation?

A. The diameter of throat should be reduced only up to a certain limited value

24. Write the formula for actual discharge.

A. $Q_{act} = \frac{AR}{t}$

25. Write the formula for theoretical discharge.

A. $Q_{th} = \frac{a_1 a_2 \sqrt{2gh}}{\sqrt{a_1^2 - a_2^2}}$

26. Write the co-efficient discharge

A. Coefficient of discharge (C_d) = $\frac{Q_{act}}{Q_{th}}$

27. Venturi meter based on which principles?

A. Bemoulli's equation.

28. What is the value of C_d for Venturi meter?

A. It is less than 1 and it may be between 0.95 and 0.99.

29. What are the applications of Bernoulli's equation?

A. Venturi meter, Orifice meter, Pitot tube, Nozzle meter

30. What is Venturi meter? And what is its use?

A. Venturi meter is a device which is used for measuring the rate of flow of fluid through a pipe

Description of Apparatus: It is a closed circuit water re-circulation system consisting of sump tank, measuring tank, centrifugal monoset pump, one pipeline fitted with venturi meter.

1. ***Venturi Meter***: Venturi meter is a device which is used for measuring the rate of flow of fluid through a pipe which consists of hose collars. Venturi meter consists of

a. An inlet section followed by a convergent cone
b. A cylindrical throat
c. A gradually divergent cone

a. Inlet Section : It is of the same diameter as that of the pipe which is followed by a Convergent cone.

Convergent cone : It is a short pipe which tapers from the original size of the pipe to that of the throat of the venturi meter

b. Throat : It is a short parallel sided tube having its cross-sectional area smaller than that of the pipe.

c. Divergent Cone : It is a gradually diverging pipe with its cross-sectional area increasing from that of the throat to the original size of the pipe.

At the Inlet section and throat, pressure taps are provided through pressure rings.

1. Total included angle of convergent cone : $21^0 \pm 1^0$
2. Length parallel to the axis of convergent cone : 2.7 (D-d)
   i. D = Diameter of the inlet section
   ii. d = Diameter of the throat
3. Length of throat : d

4. Total included angle of divergent cone : 5^0 to 15^0 (preferably about 6^0)

Diameter of throat may very from $\frac{1}{3}$ to $\frac{3}{4}$ of the pipe diameter and more commonly the diameter of the throat is kept equal to $\frac{1}{2}$ of pipe diameter.

2. *Piping System*: Consist of a pipe of size 25mm with separate control valve and mounted on a suitable strong iron stand. Separate upstream and downstream pressure feed pipes are provided. There are pressure taping valves which are ball valves and there are four manometer ball valves.

3. *Measuring Tank*: It is a stainless steel (S.S) Tank with gauge glass, a scale arrangement for quick and easy measurements. A ball valve which is outlet valve of measuring tank is provided to empty the tank.

4. *Sump Tank*: It is also a S.S. tank to store sufficient fluid for experimentation and arranged within the floor space of main unit. The sump should be filled with fresh water leaving 25 mm space at the top.

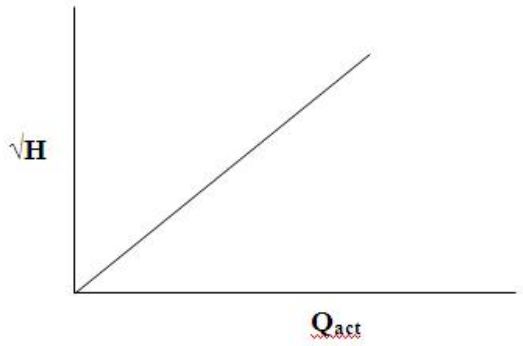
5. *Differential Manometer*: It is used to measure the differential head produced by venturi meter.

6. *Pumpset*: It is used to pump water from sump tank to measuring tank through pipe.

Theory:

A Venturi meter is a device which is used for measuring the rate of flow or discharge of fluid through a pipe. The principle of the venturi meter was first demonstrated in 1797 by Italian Physicist G.B.Venturi(1746 - 1822), but the principle was first applied by C. Hershel(1842 - 1930) in 1887.

The basic principle on which a venturi works is that by reducing the cross sectional area of the flow passage, a pressure difference is created and the measurement of the pressure difference enables the determination of the discharge through the pipe. To avoid the possibility of flow separation and the consequent energy loss, the divergent cone of the venturi meter is made longer with a gradual divergence. Since the separation of flow may occur in the divergent cone of the venturi meter, this portion is not used for discharge measurement.



Results:

Actual discharge of Orifice meter (Q_{act}) = m^3/sec

Theoretical discharge of Orifice meter (Q_{th}) = m^3/sec

Coefficient of discharge of Orifice meter (C_d) =

Viva Questions:

1. For which one, the coefficient of discharge is smaller, venturimeter or Orificemeter?

A. Orifice meter

2. What is the reason for smaller value of C_d ?

A. There are no gradual converging and diverging flow passages as in the case of venturimeter which results in a greater loss of energy and consequent reduction ofthe coefficient of discharge for an orifice meter

3. What is Orifice meter?

A. An orifice meter is another simple device used for measuring the discharge through pipes.

4. What is the principle of Orifice meter?

A. Orifice meter also works on the same principle as that of venturi meter i.e, by reducing the cross sectional area of the flow passage a pressure difference between the two sections is developed and the measurement of the pressure difference enables the determination of the discharge through the pipe.

5. For discharge measurement through pipes which is having cheaper arrangement and whose installation requires a smaller length?

A. Orifice meter

6. What are the parts of Orifice meter?

A. Flat circular plate with a circular hole

7. What is the thickness of the plate t?

   A. $t \leq 0.05d$ where d= diameter of the pipe

8. What is the range of bevel angle in orifice meter?

A. 30^0 to 45^0 (preferably 45^0)

9. What is the diameter of the orifice?

A. It may vary from 0.2 to 0.85 times the pipe diameter, but generally the orifice diameter is kept as 0.5 times pipe diameter

10. Where two pressure taps are provided?

A. One on upstream side of the orifice plate and the other on downstream side of the orifice plate.

11. Where upstream pressure tap is located?

A. It is located at a distance of 0.9 to 1.1 times the pipe diameter from the orifice plate.

12. Which diameter is less, orifice or pipe?

A. Orifice meter

13. What is vena contracta?

A. Smallest cross sectional area

14. At which section on the downstream side the pressure tap is provided quite close to orifice plate?

A. At the section where the converging jet of fluid has almost the smallest cross sectional area (which is known as vena contracta)

15. Where the velocity of flow is maximum and pressure is minimum?
A. At vena contracta

16. Maximum possible pressure difference that exists between upstream side of the orifice plate and downstream side of the orifice plate is measured by means of what?
A. Differential manometer

17. Where there is a greater loss of energy, whether in venturi meter or in orifice meter?
A. In orifice meter

18. Why there is a greater loss of energy in orifice meter?
A. Because there is an abrupt change in the cross-sectional area of flow passage

19. What is value of c_d ?
A. It is the range of 0.6 to 0.68

20. What is the manometer liquid?
A. Mercury

21. When an orifice is called large orifice?

A. When head of liquid from the center of the orifice is less than 5 times the depth of orifice

22. On what the position of downstream pressure tap depends?

A. It depends on the ratio of the orifice diameter and the pipe diameter.

Description of Apparatus: It is a closed circuit water re-circulation system consisting of Sump tank, Measuring tank, Centrifugal Monoset pump, one pipeline fitted with Orifice meter.

1. *Orifice Meter*: It is a cheaper arrangement for discharge measurement through pipes and its installations requires a smaller length as compared with venturi meter .It consists of a flat circular plate with a circular hole called orifice which is concentric with the pipe axis. The thickness of the plate t is less than or equal to 0.05 times the diameter of the pipe.

From the upstream face of the plate the edge of the orifice is made flat for a thickness t_1 less than or equal to 0.02 times the diameter of the pipe and for the remaining thickness of the plate it is bevelled with the bevel angel lying between 30^0 to 45^0. If the plate thickness t is equal to t_1, then no bevelling is done for the edge of the orifice. The diameter of the orifice may vary from 0.2 to 0.85 times the pipe diameter, but generally the orifice diameter is kept as 0.5 times the pipe diameter. Two pressure taps are provided, one on upstream side of the orifice plate, and the other on the downstream side of the orifice plate. The upstream pressure tap is located at a distance of 0.9 to 1.1 times the pipe diameter from the orifice plate .The position of the downstream pressure tap, depends on the ratio of the orifice diameter and pipe diameter.

2. *Piping System*: Consist of a pipe of size 25mm with separate control valve and mounted on a suitable strong iron stand. Separate upstream and downstream pressure feed pipes are provided. There are pressure taping valves which are ball valves and there are four manometer ball valves.

3. *Measuring Tank*: It is a stainless steel (S.S) Tank with gauge glass, a scale arrangement for quick and easy measurements. A ball valve which is outlet valve of measuring tank is provided to empty the tank.

4. *Sump Tank*: It is also S.S. tank to store sufficient fluid for experimentation and arranged within the floor space of main unit. The sump should be filled with fresh water leaving 25 mm space at the top.

5. *Differential Manometer*: It is used to measure the differential head produced by Venturi meter.

6. ***Pump set***: It is used to pump water from sump tank to measuring tank through pipe.

Viva Questions:

1. What is Bernoulli's equation?

A. $\frac{p}{w} + \frac{v^2}{2g}$ +z = Constant

2. What is $\frac{p}{w}$?

A. Pressure energy per unit weight of fluid or pressure head or static head.

3. What is $\frac{v^2}{2g}$?

A. Kinetic energy per unit weight or kinetic head or velocity head

4. What is z?

A. Potential energy per unit weight or potential head or datum head

5. What are the assumptions of Bernoulli's equation?

A. 1) The fluid is ideal (i.e, viscosity is zero)
2) The flow is steady

3) The flow is incompressible

4) The flow is irrotational

6. What Bernoulli's equation states?

A. It states that in a steady, ideal, irrotational flow of an incompressible fluid, the total energy at any point of the fluid in constant

7. For which type of fluids Bernoulli's equation is applicable?

A. For steady, irrotational flow of incompressible fluids

8. What is total head?

A. Sum of pressure head, velocity head, and potential head is known as total head

9. If Bernoulli's equation is applicable between two points what is the equation of Bernoulli?

A. $\frac{p_1}{w} + \frac{v_1^2}{2g} + z_1 = \frac{p_2}{w} + \frac{v_2^2}{2g} + z_2$

10. What is Piezometric head?

A. Sum of pressure head and potential head

11. In Bernoulli's equation each term represents what?

A. The energy per unit weight of the flowing fluid.

12. Why each term is called head?

A. The energy per unit weight of the fluid is expressed as N.m/N that is it has a dimension of length and therefore it is known as head

13. What is viscosity?

A. It is the property of fluid which offers resistance to the movement of one layer of fluid over another adjacent layer of fluid.