

EXPERIMENT NO

LOSSES IN PIPE FITTINGS

INTRODUCTION:

While installing a pipeline for conveying a fluid, it is generally not possible to install a long pipeline of same size all over for various reasons, like space restrictions, aesthetics, location of outlet, etc. Hence, the pipe size varies and it changes its direction. Also, various fittings are required to be used. All these variations of sizes and the fittings cause the loss of fluid head. The apparatus is designed to demonstrate the loss of head due to various fittings and valves.-

The set up consists of basic piping in which the fittings and valves are installed. A pressure tapping is provided at inlet and outlet of each fitting and valve. This pressure tapping is connected to mercury manometer. A gate valve at outlet and a bypass valve at pump discharge is used to control the pressure and flow of water through the test section.

SPECIFICATIONS:

1. ½ H.P. pump to circulate water through the piping.
2. Sump tank and measuring tank of suitable capacity.
3. Fittings comprising of;
Elbow, Sudden contraction, Tee, coupling, bushing, cap, plug, nipple and floor flange.
4. Valves comprising of;
Globe valve, diaphragm valve, check valve, ball valve, butterfly valve, needle valve, angle valve and stop cock.

EXPERIMENTAL PROCEDURE:

Before starting the experiment, see that the bypass valve, flow control valve & manometer base cocks are fully opened.

- 1) Fill up sufficient clean water in the sump tank.
- 2) Start the pump and close the bypass valve, so that water starts flowing through the manometer overflow tubes. This ensures that there is no air gap in the manometer piping.
- 3) Now open the bypass by few turns such that the pressure in the piping is decreased.
- 4) Select any one valve or fitting for testing of the head loss. Start the water flow only through that valve or fitting. Note down the manometer difference and time required for 10 cm rise of water in the measuring tank.
- 5) Repeat the procedure for different flow rates.

Test for ‘Tee’ : As ‘Tee’ consists of totally 3 branches. One of it will be the upstream flow line. Thus one manometer tube will be connected to this line tapping. From rest of the other two, any one line tapping may be connected to the manometer to find the head loss between those two lines at a specific flow between the lines. The study of flow may be done at all the lines with one upstream line always used. The readings may be taken at different flow rates of each downstream line.

Test for ‘valve’ : A valve has various no. of throttle openings. Thus the valve opening can be set at any specific position and its head loss can be obtained at that flow.

OBSERVATION TABLE:

Sr. no.	Type of fitting	Manometer Difference h m	Time for 10 cm rise in measuring tank. t sec

CALCULATIONS:

1) Head loss in various types of pipe fittings / valves.

In the above fittings/valves,

We have;

$$\text{Discharge 'Q'} = \frac{\text{C/s of tank} \times 0.01}{t} \quad \text{m}^3/\text{sec}$$

∴ mean area of inner dai. of a fitting/valve , A= m²

Thus, mean velocity of flow; $V = \frac{Q}{A}$ m/s

Loss of head ‘ h_{expt} = manometer diff. X 12.6 m of water.

We have,

; Actual head loss, $h_{\text{expt}} = K \cdot \frac{V^2}{2.g}$ m of water.

Co-efficient of pipe fitting, K =

2) Loss of head due to Sudden contraction:

At sudden contraction, velocity of water increases which causes pressure head to drop (according to Bemoullis theorem), in addition to this there is loss of head due to sudden contraction.

Hence,

$$\text{Water head difference} = (\text{Head drop due to increment of velocity}) + (\text{head loss due to sudden contraction})$$

Assuming no loss to be there due to contraction and applying Bemoullie’s theorem;

At inlet and outlet of the section,

$$\frac{P_i}{w} + \frac{V_i^2}{2.g} = \frac{P_o}{w} + \frac{V_o^2}{2.g}$$

Inlet size diameter ‘ di ’ =m ∴ Ai =m²

Outlet size diameter ‘ do ’ =m ∴ Ao =m²

Where, Ai and Ao are Inlet and outlet area’s respectively

Also, $V_i = Q / A_i$ m/s

Similarly, $V_o = Q / A_o$ m/s

Now,

Drop of head due to velocity increment,

$$h_v = \frac{V_o^2}{2.g} - \frac{V_i^2}{2.g}$$

∴ Actual drop due to sudden contraction ‘hc’ = (Water head diff. at sudden contraction i.e. ‘h’) – (head drop due to velocity rise i.e. ‘hv’)

or Loss of head due to sudden contraction;

$$h_c = h - h_v$$

We have,

$$\text{Actual head loss, } h_{\text{expt}} = K. \frac{V^2}{2.g} \quad \text{m of water.}$$

$$K = \text{-----}$$

Actually, value of 'K' depends upon inside diameter, curvature radius, turbulence, surface roughness and many other factors Hence, it is better to determine the value of 'K' experimentally for that specific joint.

CONCLUSION:

For any type of fitting, there is a loss of head, but its magnitude depends upon the type of fitting. Loss of head occurs due to change in magnitude or direction of the fluid velocity.

PRECAUTIONS:

- 1) Operate the valves gently. Do not force to rotate them.
- 2) Always use clean water for the experiment.