Subject : Fluid Mechanics

Question : What are Minor loss and Major loss?

Answer :

There are two types of head losses in pipe flow systems i.e. Major head loss and Minor head loss.

If head loss in pipe flow systems is due to viscous effect i.e. due to friction, it will be termed as major head loss and will be indicated by $h_{L\text{-}Major}$.

If head loss in pipe flow systems is due to various piping components such as valves, fittings, elbows, contractions, enlargement, tees, bends and exits, it will be termed as minor head loss and will be indicated by $h_{L\text{-}Minor}$.

Therefore, complete head loss or pressure loss in pipe flow will be the summation of major head loss and minor head loss and it will be indicated by h_L.

$$\mathbf{h_L = h_{L\text{-}Major} + h_{L\text{-}Minor}}$$

Major Head losses

Major Head losses in pipe flow problem will be calculated with the help of Darcy-Weisbach formula as mentioned below; it does not matter whether the pipe is horizontal, vertical or on an inclined plane.

$$h_{L\text{-}Major} = f\frac{(L)(V^2)}{2(g)(D)}$$

Where

$h_{L\text{-}Major}$ = head loss in ft or m.
f = Darcy-Weisbach friction factor
D= Diameter of pipe (ft or m)
L= Length of pipe (ft or m)
v= flow velocity (fps or mps)
g= gravitational acceleration

Friction factor as mentioned above will be determined on the basis of type of flow.
The equations given below are used for calculating friction factor.

Laminar Flow: $f = \frac{64}{Re}$

Smooth Pipe Turbulent Flow: $f = \frac{0.316}{Re^{1/4}}$

Completely Turbulent Flow: $f = [1.14 + 2\log_{10}(\frac{D}{\varepsilon})]^{-2}$

Transition Region: $f = \{-2\log_{10}[\frac{(\varepsilon/D)}{3.7} + \frac{2.51}{Re(f^{1/2})}]\}^{-2}$

Minor Head loss

As we have discussed above, minor head losses are pressure losses in pipe flow systems due to various piping components such as valves, fittings, elbows, contractions, enlargement, tees, bends and exits.

$$h_{L\text{-Minor}} = K\frac{V^2}{2g}$$

Where K is termed as minor loss coefficient and values of minor loss coefficient, K for various piping components or fitting are given in the following table.

Type of Piping Components or Fittings	Minor loss coefficient, K
Tee, Flanged, Dividing Line Flow	0.2
Tee, Threaded, Dividing Line Flow	0.9
Tee, Flanged, Dividing Branched Flow	1.0
Tee, Threaded , Dividing Branch Flow	2.0
Union, Threaded	0.08
Elbow, Flanged Regular 90^o	0.3
Elbow, Threaded Regular 90^o	1.5
Elbow, Threaded Regular 45^o	0.4
Elbow, Flanged Long Radius 90^o	0.2
Elbow, Threaded Long Radius 90^o	0.7
Elbow, Flanged Long Radius 45^o	0.2
Return Bend, Flanged 180^o	0.2
Return Bend, Threaded 180^o	1.5
Globe Valve, Fully Open	10
Angle Valve, Fully Open	2
Gate Valve, Fully Open	0.15

Gate Valve, 1/4 Closed	0.26
Gate Valve, 1/2 Closed	2.1
Gate Valve, 3/4 Closed	17
Swing Check Valve, Forward Flow	2
Ball Valve, Fully Open	0.05
Ball Valve, 1/3 Closed	5.5
Ball Valve, 2/3 Closed	200
Diaphragm Valve, Open	2.3
Diaphragm Valve, Half Open	4.3
Diaphragm Valve, 1/4 Open	21
Water meter	7