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EQUIVALENT LENGTH: REVIEW ON RESEARCH AND STUDIES

Sunil Jayant Kulkarni[1]
[1]Chemical Engineering Department, Datta Meghe College of Engineering, Airoli, Navi Mumbai, Maharashtra, India,

ABSTRACT

The equivalent length is a concept introduced to have an idea about pressure losses due to different types of fittings. Valves, ventury meters, bends etc. are inherent parts of piping systems. Equivalent length of fitting gives estimate about length of the pipe which will give same pressure drop as that of the fitting under same conditions. It is the length of pipe of the same size as the fitting that would give rise to the same pressure drop as the fitting. The head loss, hL, increases as the values of Q increases regardless of type of bend and gate valve placed in the pipe line. Experimental set-up and conditions play vital role in selection of the method for data analysis. Many investigators have studied the methods to determine equivalent length. Current review summarizes research and studies on equivalent length.

KEYWORDS: *Friction, roughness, pressure drop, parameters.*

1. INTRODUCTION

Fluid flow operation deals with the behavior fluid. Compressible and incompressible are two important types of fluids. Incompressible fluids are mostly liquids. Various studies are reported on behavior of incompressible fluids regarding hydrodynamics in beds [1-4]. Also studies on behavior of compressible-incompressible fluids under various operating conditions are reported [5-7]. Friction is very important factor in energy requirement and life of equipment. Friction in pipe increases pressure drop and hence increases power requirement [8-12]. It is necessary to have proper and accurate estimates about friction. The equivalent length is a concept introduced to have an idea about pressure losses due to different types of fittings. Valves, ventury meters, bends etc. are inherent parts of piping systems. Equivalent length of fitting gives estimate about length of the pipe which will give same pressure drop as that of the fitting under same conditions. The length of pipe of the same size as the fitting that would give rise to the same pressure drop as the fitting. The important thing to note for the pressure drop across a fitting is how the geometry of the fitting causes changes in the direction and velocity of the fluid flow. The studies indicate that the friction between the fluid and the fitting walls has a relatively minor effect on the pressure drop. The roughness of that pipe has strong effect on equivalent length. Many investigators have studied the methods to determine equivalent length. Current review summarizes research and studies on equivalent length.

2. EQUIVALENT LENGTH: REVIEW ON RESEARCH AND STUDIES

Ntengwe et.al. carried out an investigation on friction losses in pipes and fittings[13].They investigated the impact of flow rate (Q) on the head loss (h_l) in pipes and fittings on different sizes or diameters (D) of pipes. Other fittings such as gate valve, 45 and 90^o bends using water as process fluid

were considered. They used the Darcy-Weisbach, Hazen-Williams and Poisselli's methods for friction losses. They observed that the head loss, h_L, increased as the values of Q increased regardless of type of bend and gate valve placed in the pipe line. They also found that, irrespective of whether the pipe was rough or smooth, gate valve h_L losses could not be eliminated but can be reduced by increasing the D of the pipe. Their studies also indicated that entry losses could only be decreased by increasing diameter. It was found that h_L increased with the increase in velocity or Q regardless of size of pipe. Dongen and Edward carried out efflux time experiments [14]. These experiments, according to them, are simple to construct, simple to operate, and very useful for teaching the fundamentals of fluid flow, friction loss, and data analysis. They used an experimental apparatus involving, a supported tank with some means of gauging or monitoring liquid level. According to them, experimental set-up and conditions plays vital role in selection of the method of data analysis. They concluded that simplicity of the apparatus and its operation allows students to concentrate more on the data analysis. In their investigation, Patil et. al. created three dimensional models of chilled water piping system[15] .For the modeling, they used design modeler of Ansys-13. By using this software they analyzed flow through chilled water pipe for pressure drop prediction. At high pressure drop results by ISHARE and Carrier showed similar results as that of CFD solution. They observed variation of 1.85% to 7.75% by this method. CFD method, according to them, can be used for pressure drop prediction in chilled water piping system. Sodiki and Adigio reviewed the development and application of methods for estimating head loss components in water distribution pipework [16]. Their paper outlined the development of the Hazen-Williams and D"Arcy-Weisbach equations.

Smith carried out in detail studies on friction losses in pipe fittings and valves [17]. They observed that curves obtained were identical in shape for all the fittings. Also the equivalent length was almost constant for Reynolds numbers between 1100 and 3000. Also they observed that the equivalent length was a function of Reynolds number. The most important error occurred was one in the manometric readings. Al-Mubaiyedh emphasized the fact that pipe fittings such as valves, elbows, T's, sudden expansions and contractions introduce additional frictional losses in a piping system [18]. These fitting sometimes cause frictional losses which are high and comparable to the frictional losses through the pipe itself. The concept of equivalent length was introduced to quantify the frictional losses due to pipe fittings. Fester et.al. carried out studies on the loss coefficient data for laminar flow of non-Newtonian fluids in pipe fittings [19].Their review also dealt with laminar and turbulent pipe flow of non-Newtonian fluids and the application of viscometry for flow in pipes and fittings. Their studies indicated that, both the zero and infinite shear viscosities increased as the concentration or molecular weight is increased or the temperature is decreased. According to them, Minor losses are important in the efficient design of pipelines in laminar flow. These losses are order of magnitude larger than those in turbulent flow. Broadfoot et.al. carried out an investigation on pressure drop losses at low Reynolds numbers[20].

3. CONCLUSION

Valves, ventury meters, bends etc. are inherent parts of piping systems. Equivalent length of fitting gives estimate about length of the pipe which will give same pressure drop as that of the fitting under same conditions. The length of pipe of the same size as the fitting that would give rise to the same pressure drop as the fitting. The head loss, h_L, increased as the values of Q increased regardless of type of bends and gate valve placed in the pipe line. Studies revealed that Minor losses are important in the efficient design of pipelines in laminar flow. These losses are order of magnitude larger than those in turbulent flow.

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