

An Experimental Study of Loss Characteristics of Gate Valves.

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Abstract :

Measurements are given for the loss coefficients of gate valves of different diameters at different percentage of openings. It is found that for all the valves, maximum head loss takes place at 30% of valve opening and the loss coefficients vary between 25 to 35 percent. It is also considered that loss coefficients do not vary considerably with discharge for all the valves.

Introduction :

Gate valves are widely used in pipelines to control the flow because of its low energy loss. One important use is in the performance tests of a centrifugal pump. While determining the suction characteristics of a centrifugal pump, a gate valve is often used to alter the suction lift. The effect of closure of the valve is comparable to increasing the suction lift. For this kind of use, it is

necessary to know the loss coefficients $\left(k = \frac{H_f}{V^2/2g} \right)$

at all valve openings. Only the loss coefficients at full and half valve openings are available in references [1, 2, 3, 4] and it appears these are not available at other valve openings. So this experimental work has been undertaken to determine loss coefficients of four valves of different sizes at various percentage openings.

Method :

The experimental setup consists of an orifice-meter and a control valve placed upstream in a 2 inch pipeline. The schematic diagram is shown in figure-1. A short vertical piece is fitted in down-

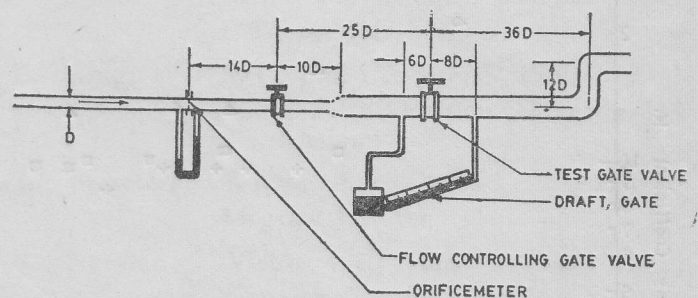


Figure. 1 Schematic Diagram of Experimental Setup

stream side to ensure full running pipe. All the fittings and pressure tappings are located at least 6D apart to avoid disturbances in the flow. Crane

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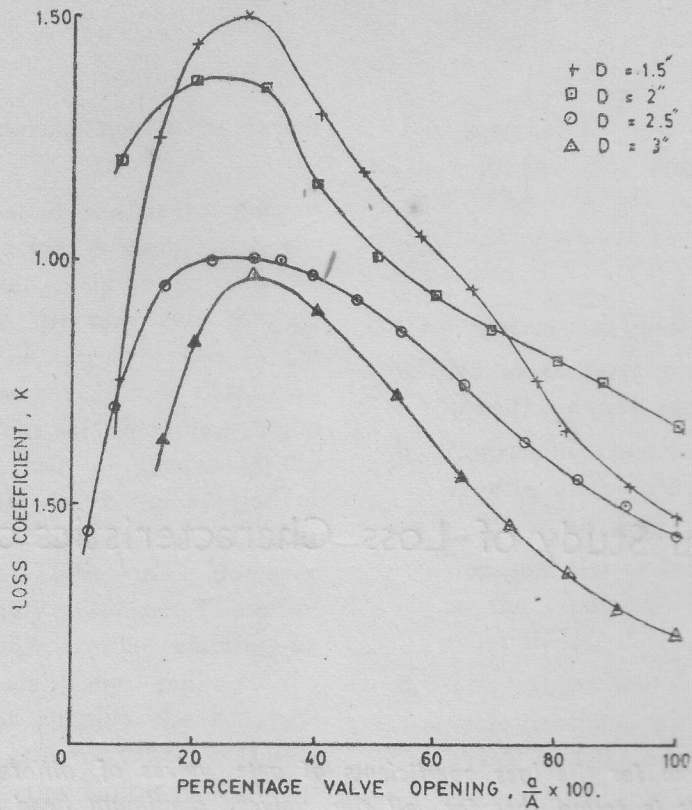


Figure : 2 Loss Coefficient-percentage valve opening relationship for different Diameters Gate Valves.

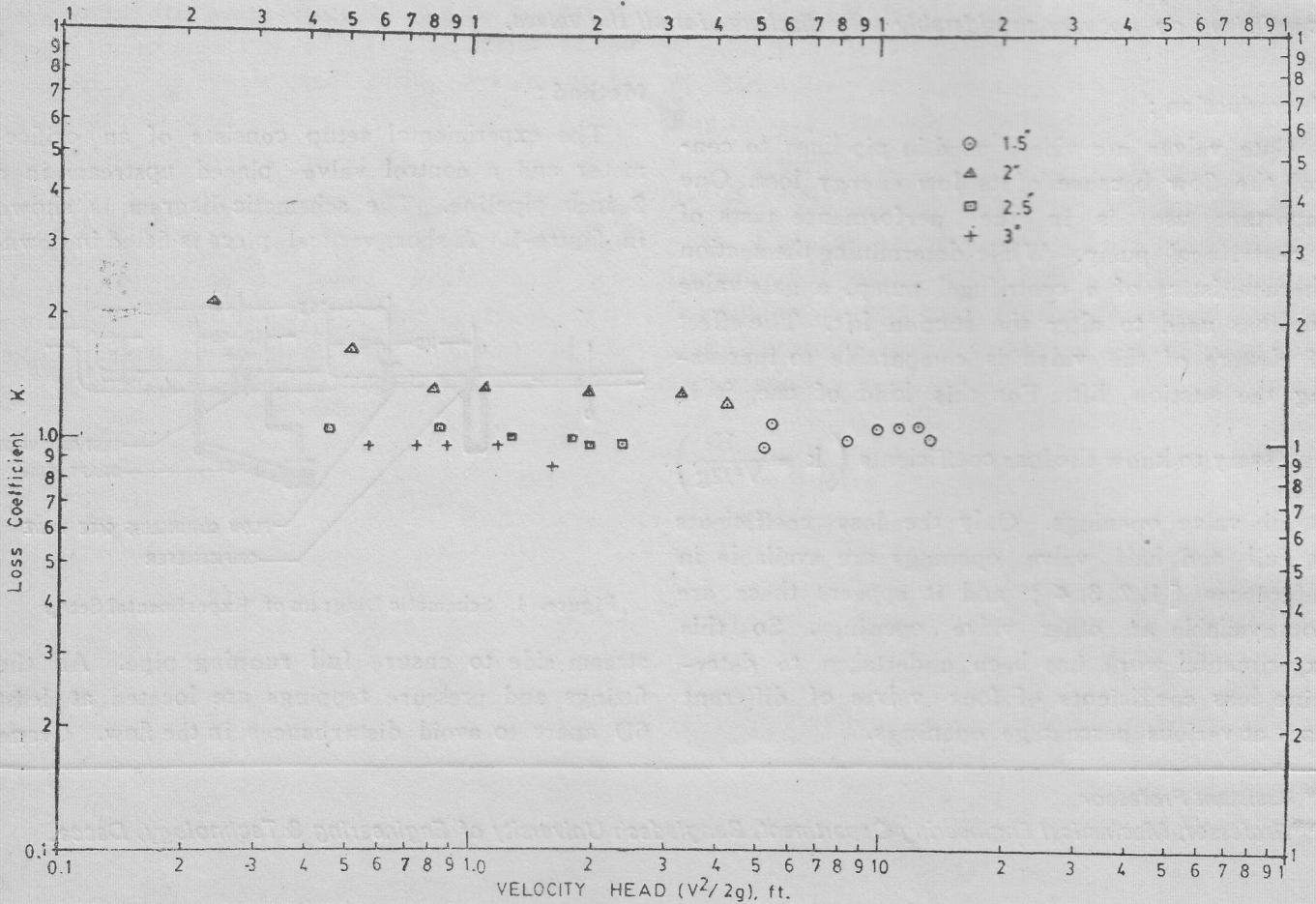


Figure : 3 Loss Coefficient-Velocity head relationship for 30% Valve Opening.

(B.S. 1952) gate valves of $1\frac{1}{2}$, 2, $2\frac{1}{2}$ and 3 inch sizes are used. There were no fluctuation and unusual sound in the flow, establishing absence of cavitation at various valve openings. The percentage area opening was calibrated geometrically in terms of the vertical displacements for each of the valve stems. A draft gage was used to measure the head loss across the gate valve. The range of Reynolds number based on valve size was between 2.03×10^4 to 10.6×10^5 . The percentage variation of loss coefficient at each opening was found out by plotting loss coefficients for all the valves. A plot of these at 30 percent valve opening is shown in figure 3. From the maximum and minimum values of loss coefficients, the percentage variation of loss coefficients are calculated for each percentage area opening.

The result at full opening is in agreement with references [1, 5]. It is hoped that results would complete the informations available on the loss coefficients of gate valve.

discussion :

The variation of loss coefficient with valve opening and velocity head are shown in figures 2, 3 and 4. It is found that maximum head loss takes place at 30 percent valve opening for all the valves. Minimum head loss is for wide opening of the valves. From figure 2 loss coefficient for any percentage of opening can be found out. Loss coefficient does not change appreciably with velocity head. This has become apparent from figure 3, which is only for 30% valve opening. This is also true for any percentage of valve opening. From figure 4, percentage variation of loss coefficient for any percentage of valve opening can be found out. Minimum variation loss coefficient takes place at half opening of the valves.

As the loss coefficient of gate valves (except at full opening) are not available, the results would serve a useful purpose to find out these values at various valve openings.

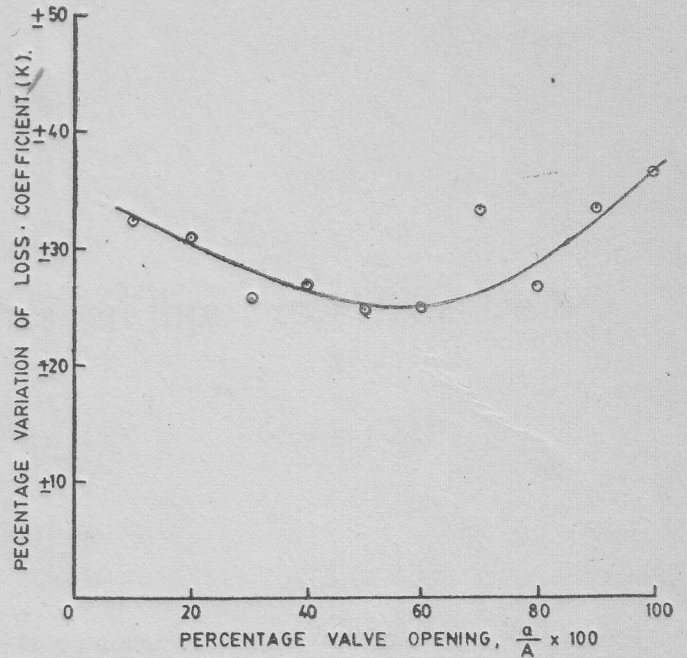


Figure : 4 Percentage Variation of Loss coefficient and percentage Valve opening relationship.

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