Headloss through a valve

Fluid Mechanics Lab Head Loss Through a Valve April 24, 2012 Abstract This experiment determined the relationship between the head loss through a gate valve and the degree of opening of that valve with varying flow rates. The objective of this experiment was to determine the valve loss coefficient, K, for a specific gate valve as a function of both the pipe Reynolds Number, and the degree of opening. The relationship between the Reynolds Number and the friction factor was constant. Regardless of what the Reynolds Number was, the friction factor remained the same.

This means that the valve head loss coefficient, K, only depended on the degree of opening of the gate valve. As the valve is slowly turned closed, the Major Head Loss due to friction along the pipe, decreases, and the Minor Head Loss, due to the friction through the gate valve, increases. There is a positive linear relationship between the Reynolds Number and the head loss coefficient. The slope of this linear relationship showed that as the flow rate increases, the velocity increases which means the Reynolds Number gets bigger and the head loss coefficient increases.

Therefore, the higher the flow and the smaller the degree of opening of the gate valve, the greater the head loss becomes through the gate valve. Table of contents

 Introduction Background Gate valves are frequently used when constructing and fitting pipes. They provide the capability to shut off specific lines so that repairs or renovations can be made without having to turn off the main supply lines. Although these valves are useful, they also disturb the normal flow and cause friction. Theory The head loss coefficient, K, for a gate valve is related to the Minor Head Loss, Hlm, where Hlm= V22gK.

The total head loss in the pipe is divided into two parts: the Major Head Loss, Hf, due to the pipe friction over length L, and the Minor Head Loss. Using the Bernoulli's energy equation, the coefficient, K, can be found: K= 2g? PV2? -fLD. Objective The objective of this experiment was to determine the valve loss coefficient, K, for a specific gate valve as a function of both the pipe Reynolds Number, and the degree of opening. Apparatus and Supplies * 1 Weighing Tank with Dump Valve (±0. 5 lb) * 2 Stop Watches (±0. 01 sec) * Galvanized Iron pipe 27 inches (±0. 03125 in) long with a diameter of 1. 1 inches (±0. 0005 in) * 1 Pressure Differential Gauge (±0. 05 psi) * 1 Valve located in between the Pressure Differential Gauge on Galvanized Iron Pipe Figure 21: Pressure Differential Gauge ? p. Weighing Tank Dump Valve Figure 22: Weighing Tank with Dump Valve open. Figure 23: Pressure Differential Gauge between Valve Set-up Procedures 1. Measure the distance between the upstream and downstream pressure tabs. 2. Turn the handle on the gate valve to determine how many turns exist between fully-opened and fully-closed. 3. Turn on the pump and open the dump valve in the weighing tank. 4.

Turn the gate valve so that it is completely open. 5. Record the Pressure Difference 6. Close the dump valve in the weighing tank. 7. Start and stop the stopwatches over a 100 lb difference and record the times. 8. Open the dump valve in the weighing tank and allow water to drain into the sump. 9. Change the flow of water. Do not change the gate valve. 10. Repeat steps 5-8. 11. Turn the gate valve to 75% open. 12. Change the flow of water. 13. Repeat steps 5-9 a total of three (3) times. 14. Turn the gate valve to 50% open. 15. Repeat steps 12 and 13. 16. Turn the gate valve to 25% open. 17. Repeat steps 13 and 13.

Equations Head Loss Coefficient: K= 2g? pV2? -fLD Major Head Loss: hf= fLDV22g Minor Head Loss: hlm= KV22g Reynolds Number: Re= VD? Area of Pipe2: A=? 4D2 Velocity: V= QA1 Volumetric Discharge: Q=? W? t*? Experimental Results Table 51: Constants and given values. Table 52: Measured Data. The friction factor f= 0. 049 was calculated based on Ks/D and the Reynolds Number. Table 53: Volumetric Flow, Velocity, Reynolds #, Head Loss Coefficient. Table 54: Real values of K, Major Head Loss, Minor Head Loss. Error Analysis There were some values calculated for the valve loss coefficient, K, which were negative.

This is impossible because a negative K value would give you an overall gain in energy as water flows through the valve according to Bernoulli's energy equation. According to the equation used, gravity and the specific weight of water are constant. The length and diameter of the pipe along with the velocity had relative errors due to human accuracy, but all of these were negligible. This leaves the friction factor, f, and the pressure differential readings. The calculated value of the friction factor was given and was probably over estimated and the absolute roughness of the pipe was less.

The accuracy of the pressure differential gauge was also a possible source of error. Looking at the data, the first five readings all had negative K values and they all had very low pressure differential readings. The accuracy of the readings become more inaccurate the closer the readings are to the endpoints of the scale. Conclusions According to the Moody Diagram and the absolute roughness stated, the relationship between the Reynolds Number and the friction factor was constant. Regardless of what the Reynolds Number was, the friction factor remained the same.

This means that the valve head loss coefficient, K, was only depended on the degree of opening of the gate valve. As the valve is slowly turned closed, the Major Head Loss due to friction along the pipe, decreases, and the Minor Head Loss, due to the friction through the gate valve, increases. There is a positive linear relationship between the Reynolds Number and the head loss coefficient. The slope of this linear relationship showed that as the flow rate increases, the velocity increases which means the Reynolds Number gets bigger and the head loss coefficient increases.

Therefore, the higher the flow and the smaller the degree of opening of the gate valve, the greater the head loss becomes through the gate valve. Recommendations for Further Studies The experiment could set minimum and maximum standards for readings off the pressure differential gauge. For each valve reading, making the minimum pressure difference greater than 1.

0 PSI and less than 9 PSI would ensure that there are no endpoint inaccuracies. References Giles, Ranald V. , Jack B. Evett, and Cheng Liu. Schaum's Outline of Fluid Mechanics and Hydraulics. New York: McGraw-Hill, 2009. Print. Appendix