Free report on lab 8

Health & Medicine, Addiction

Executive summary:

As a fluid flows through a pipe, there are numerous losses due to the nature and characteristic of the pipe. Such losses can be investigated in the laboratory by setting up an experiment. This report, presents the results and discussion of an experiment set up to investigate fluid flow. The laboratory experiment is designed in order to determine the relationship between the head losses resulting due to friction and the velocity of flow of the water. Secondly, the experiment is aimed at comparing the measured and calculated values of head loss determined using the pipe friction equation. The data was collected by following the laboratory procedure laid out.

Introduction

When a fluid flows through a pipe it, experiences head losses that result due to major head losses and minor head losses. The major head losses are mainly attributable to friction within the pipe while the minor head losses are mainly due to the various components of the pipe such as bends. When a fluid flows through a pipe, there are two types of flows. These are laminar flow and turbulent flow. Laminar flow occurs when the fluid is flowing at low velocity while turbulent flow occurs when the fluid flows are higher velocities. For laminar flow hf u while for turbulent flow hf un where hf is the head loss and u is the velocity of the fluid in the pipe. The head losses that are experienced in the pipe occur due to friction between the walls of the pipe and the fluid.

The goals of the experiment are:

- Determining the relationship between the head losses resulting due to friction and the velocity of flow of the water

Procedure

Materials:

- C6-MKII-10 Fluid Friction Apparatus
- Pipe samples
- C6-50 data logging accessory

Procedure

- The tank in the hydraulic bench was checked in order to ensure that it was filled with water at least 75% of its volume
- The transparent tube from the C6-MKII-10 apparatus was connected to the outlet of the hydraulic bench in order to provide water for the apparatus
- The hydraulic bench was then plugged in
- Valves were opened and closed as needed in order to allow water to flow through the desired pipes
- The pump was started and the valve on the hydraulic bench to supply the apparatus with water
- The flow rate of the water was set to a high discharge to eliminate bubbles that would introduce errors
- The flow rate was set to a minimum and it was increased nine times in order to collect 10 different trials for the three pipes
- The head loss due to friction in each pipe was determined using computer software

- The flow rate reading was taken from all the four pipes separately

- The length between the two tappings in the pipe was measured and recorded

- The volumetric flow rate for each trial was also measured and recorded. The measuring cylinder was used for small flow rates

- The internal diameter of each test pipe was determined using a Veriner caliper

Analysis and Results

The data collected for the experiment is as shown in the Excel table below. The table shows the flow rate, diameter, area, and measured Hf for the three pipes used in the experiment. Each pipe has ten sample readings.

Pipe one (diameter = 0. 0172 m):

Chart 1: Chart showing the head loss (m) vs. the velocity (m/sec) for pipe 1

Char 2: Chart showing the log head loss (m) vs. log velocity (m/sec) for pipe 1

Pipe two (diameter = 0. 0112m):

Chart 3: Chart showing the head loss (m) vs. the velocity (m/sec) for pipe 2

Chart 4: Chart showing the log head loss (m) vs. log velocity (m/sec) for pipe 2

Pipe three (Diameter = 0. 0078):

Chart 5: Chart showing the head loss (m) vs. the velocity (m/sec) for pipe 3

Chart 6: Chart showing the log head loss (m) vs. log velocity (m/sec) for pipe

2

Reynolds’ number calculation

For pipe 1, the critical Reynolds’ number can be calculated as:

The minimum value is:

= (999 * 0. 11 * 0. 0172) / 1. 15 x 10-3

= 1. 8901 / 1. 15 x 10-3

= 1643. 5

The maximum value is:

= (999 * 0. 46 * 0. 0172) / 1. 15 x 10-3

= 6873. 12

For pipe 2, the critical Reynolds’ number can be calculated as:

The minimum value is:

= (999 * 0. 35 * 0. 0112) / 1. 15 x 10-3

= 3405. 28

The maximum value is:

= (999 * 0. 72 * 0. 0112) / 1. 15 x 10-3

= 7005. 16

For pipe 3, the critical Reynolds' number can be calculated as:

The minimum value is:

= (999 * 0. 3 * 0. 0078) / 1. 15 x 10-3

= 2032. 75

The maximum value is:

= (999 * 0. 91 * 0. 0078) / 1. 15 x 10-3

= 6166

Head loss calculation

The value of head loss can be determined as:

For the data collected, the head loss for pipe 1 can be calculated as:

= 0. 07 (0. 0052/ 0. 0172) (0. 112 / 2 * 9. 8)

= 0. 625

The measured value of head loss from the experiment is 0. 65

Error between the measured and calculated value = (0. 65 – 0. 625) / 0. 65

%

= 3. 8%

Discussion of Results

The value theoretic and calculated head loss are close to each other. The calculated value of head loss is 0. 625 while the measured value of head loss for pipe 1 is 0. 625. The percentage difference in the theoretic and calculated head loss values is 3. 8%.

Examining the data, it is evident that at the same flow rate the head loss varies according to the pipe size. Based on the data, in pipe 1 (diameter = 0. 0172) water with a flow rate of 0. 46 m/s2 has a measured head loss of 10. 44. However, in pipe 2 (diameter = 0. 0112) water with a flow rate of 0. 46 m/s2 has a measured head loss of 2. 1. This indicates that at the same flow rate the head loss varies according to the pipe size. The main reason for this deviation is that head loss and diameter of the pipe are directly proportional. The friction factor and the Reynold's number have a direct relationship. If the friction factor increases so does, the Reynold's number and vice versa.

Conclusion

The main highlights from the results obtained include the following. First, it is clear that at different flow rates the measured Hf differs. The results of the experiment also show that the head loss and the velocity are directly proportional to each other. The experiment also indicate that at the same flow rate the head loss varies according to the pipe size. In laminar, transitional and turbulent flow, the Reynold's number increases as the flow changes from laminar to turbulent. The Reynold's number and Moody diagram are important in real life since they are significant in the design and development of pipes and piping systems. Accuracy in the lab can be increased by utilizing apparatus with higher sensitivity.

Appendix: Raw Data