SCHOOL OF NUCLEAR ENGINEERING

Purdue University

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NUCL 355

Experiment #2

Reynolds Experiment

Objectives

1. Using flow visualization technique, determine the flow pattern for different tubes.
2. Using the measured pressure drop determine the friction factor “f” experimentally for different tubes.
3. Demonstrate the effect of pipe roughness on the flow.
4. Calculate the pressure loss in the tube and compare it with the measured values.
5. Study Entrance Effect.
6. Demonstrate with calculation the use of this experiment in evaluating drain flow rates in tubes from vessel containing liquids.

Experimental Apparatus

Fully assembled experimental apparatus is shown in Fig 1. The apparatus consist of a large rectangular tank (2), containing a mechanism (4) to adjust liquid level in the tank, a honey comb structure (6) to suppress the turbulence caused by the incoming water.

A stop watch, water collecting tank (9), weighting scale and graduated cylinder are used to measure the liquid flow rate. A die injection system (10) is used for the flow visualization technique.

All tubes used are of the same length, 47.0-in except one smooth tube with smooth entrance, which is 50.0-in long. Tubes of four different diameters and types are used.

Their types and other dimensions are:

Type	Dimensions (ID)
Smooth tube	0.250, 0.500
Rough tube	0.500
Pressure tape tube	0.250

Procedure

1. Attach a smooth tube (1) of small diameter to the water reservoir (2) with the help of plexiglass coupling (3), the coupling (3a) with long bolts fixed on the reservoir, can be attached (3b) to the end flange of the tube. Make sure that tube is perfectly horizontal with

the help if tube stand (8) and spirit level.
2. In the beginning adjust water leveling mechanism (4) to obtain highest level of water in the reservoir, by opening the water inlet valve (5) as shown.
3. Adjust the flow rate through the inlet value, until a constant water level with a small amount of overflow at the water leveling mechanism is achieved.
4. Start due injection and wait for the flow to be steady, well developed before recording the observation for the pattern. After the observation turn off the dye injection.
5. Record the water level in the reservoir from the scale (11) and measure the flow rate by collecting water in the collection tank for a period of time. With large diameter tube (for which the flow rate is large) measure the flow rate atleast 4-5 times ans then take the average. For smaller diameter tubes (for which the flow rate is small) 2-3 reading of larger duration (5 minutes) may be required. However use your judgment to get the best average measurements.
6. Lower the water level in the reservoir and maintain a constant level as explained in step2.
7. Repeat step 4 and step 5.
8. Repeat step 6 and 7.
9. Drain the water in the reservoir with the help of water leveling mechanism (4).
10. Choose another small diameter tube and repeat step 1 to 9.
11. Repeat step 10 for rest of the smooth tubes.
12. Use the rough tube to repeat step 1 to 9.
13. Use the pressure tap tube, repeat step 1 to 9. The water height of the ten pressure tube along the tube length (1) should be recorded for each of the flow rate studied earlier (all water reservoir levels). Reservoir level should correspond to the once used for the 0.250-inch smooth tube.

Data Analysis

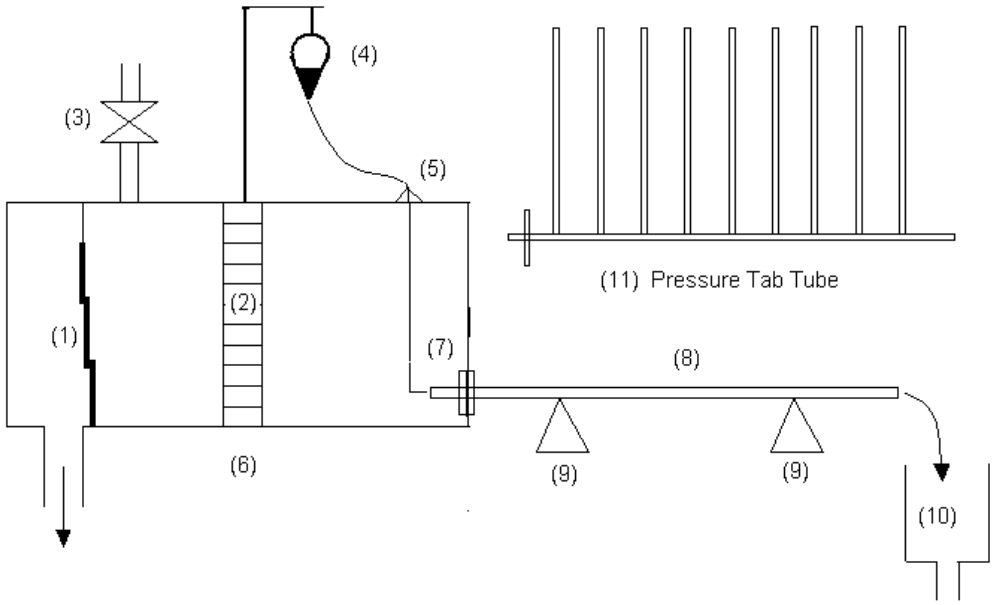
Compare the friction factors obtained experimentally against the theoretical values. The best way to perform this comparison is to plot the experimental values on the Moody chart.

Reference

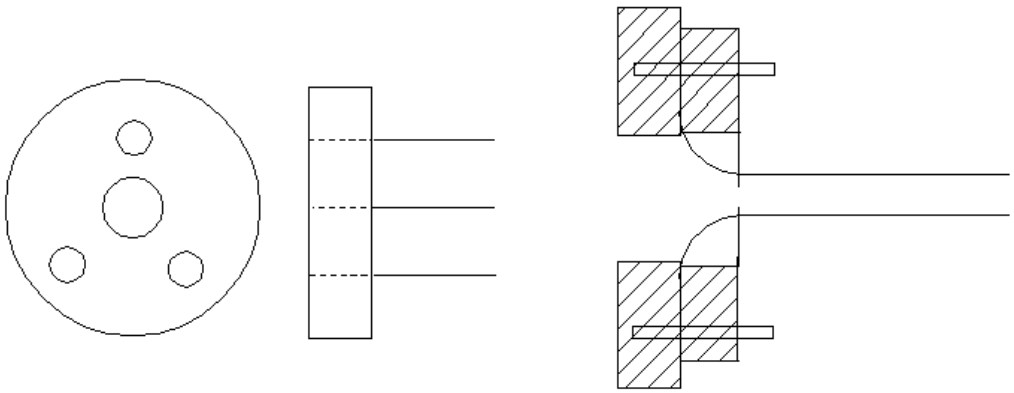
1. Robert W. Fox, Alan T. McDonald, Philip J. Prichard, *Introduction to Fluid Mechanics*, 6^{th} ed., New York, Wiley, 2004.

Precautions

1. Do not disturb the experimental apparatus during the flow visualization of flow regimes.
2. Take special care while handling the long tubes and dye injection mechanism.



(1) Gates to matain water level (2) Flow Homogenizer (3) Inlet Flow (4) Dye Flank
(5) Dye Injector (6) Supply Tank (7) Connecting Flange (8) Test Tubes (9) Leveller
(10) Drain Tank



(7)a (7)b (7)c

Figure 1 Reynolds Experiment