FRICTION FACTOR IN INTERNAL PIPE TURBULENT FLOW

AIM

The objective of this experiment is to determine the frictional losses in straight pipes.

EXPERIMENTAL SETUP

Four pipes of different diameters and different material, control valves, sump tank U-tube manometers.

THEORY

When the fluid flows through pipe, it is subjected to resistance due to shear forces between fluid &wall and also between fluid layers. This resistance is called as 'frictional resistance'. This resistance depends on various factors such as fluid properties, velocity, and wall roughness factor.

PROCEDURE

Fill the sump tank with sufficient clean water. Open the outlet valve of pump and start the pump. Open the outlet valve of pipe to be tested. Remove all the air bubbles from manometer & connecting pipe. Adjust the flow such that the reading of the pressure transmitter is stable. Note down the pressure drop and the flow rate. Now increase the flow(operate outlet valve also so that there is no overflow) and take readings. Repeat the same procedure for other pipes.

SPECIFICATIONS

Four pipes:

S.S. pipe with internal diameter (I.D.) = 9.54mm

S.S. pipe with I.D. = 16.72 mm

S.S. with I.D. = 6.88mm

S.S. with I.D. = 3.44mm

Test length of pipe = L = 1 m

Roughness of SS pipe = 0.015 mm

SPECIMEN CACULATIONS

1. Discharge: $Q = \frac{0.001}{t}$ m^3/sec

2. Velocity of flow: $V = \frac{Q}{A}$ m/sec

Where, Area, $A = \frac{\pi}{4} \times D^2$ m^2 (D = inside diameter of pipe.)

3. According to Darcy-Weisbach equation, $h_f = \frac{fLV^2}{2gD}$

Where, f = friction factor

Then,

$$f = \frac{2gDh_f}{LV^2}$$

4. According to Colebrook correlation $\frac{1}{\sqrt{f}} = -2.0\, log_{10}\left(\frac{\varepsilon/_D}{3.7} + \frac{2.51}{Re\sqrt{f}}\right)$

OBSERVATION TABLE

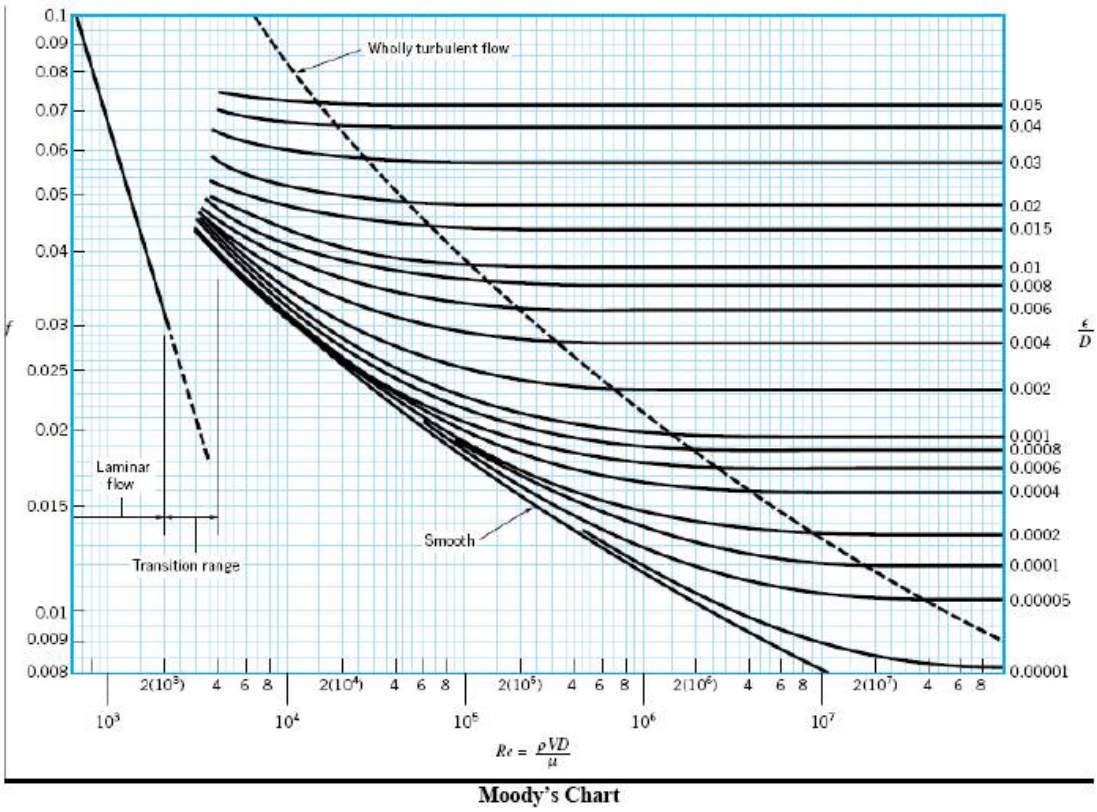
Pipe	Sr. No.	Pressure drop (Pa)	Discharge '*Q*' (m^3/sec)	Velocity '*V*' (m/s)	*f*(expmt)	*Re*	*f* (Cole brook relation)	*f*(Moody's chart)
3.44 mm SS pipe	1							
	2							
	3							
	4							
	5							
6.5 mm SS pipe	1							
	2							
	3							
	4							
	5							
9.5 mm SS pipe	1							
	2							
	3							
	4							
	5							
16.5 mm SS pipe	1							
	2							
	3							
	4							
	5							

GRAPHS:

1. Plot a graph of friction factor, *f* (expt) vs Reynolds number.

CONCLUSION/DISCUSSION ON THE RESULT:

1. What is the roughness of the pipe?
2. Write down the observations.
3. Try to explain the results from theory studied earlier.



Moody's Chart

FURTHER READING

1. Introduction to Fluid Mechanics 8th Edition, by *Fox, Robert W. and McDonald,* Alan T., Chapter 8

TEACHING ASSISTANT: