PIPE FLOW FRICTION LAB

PURPOSE: The main purpose of this lab is to measure the pipe flow friction factor f for a copper pipe and to use this to estimate the pipe roughness.

PROCEDURE: Set the water flow rate down the pipe using the control valve. For each valve setting, measure the flow rate by collecting water in a bucket for a set period of time and the head loss along the pipe using the plastic tubes attached to the setup.

REPORT: Using the measured data, calculate the friction factor for the pipe. Plot this on the Moody Chart. From the chart estimate the pipe roughness.

PIPE FLOW THEORY

When there is a flow in a pipe, a pressure drop occurs along the length of the pipe due to wall friction. The pressure drop can be converted into an equivalent height of fluid or head loss. This is

$$h_L = [P_U - P_D] / [\rho g]$$

where U indicates the upstream end of pipe and D indicates the downstream end of pipe. Theory shows that the head loss can also be written as

$$h_L = f\ L/D\ C^2/[2g]$$

where C is flow speed, L is pipe length and D is pipe diameter. The flow speed is Q/A where Q is volumetric flow rate and A is pipe area. One can use measured data to calculate the friction factor f and the Reynolds Number $\rho CD/\mu$. These can be plotted on the Moody Chart. One can get the pipe roughness from the Moody Chart.

DATA SHEET FOR PIPE

RUN	HEAD LOSS	WEIGHT	TIME

Moody diagram (friction factor f versus Reynolds number $Re = \dfrac{\rho v D}{\mu}$ for various relative roughness $\dfrac{\varepsilon}{D}$)