School of Nuclear Engineering
Purdue University
West Lafayette, IN 47907
***NUCL 355* Nuclear Thermal-Hydraulics Laboratory**

Experiment 7: Drag Force on Sphere

Objectives

1. Demonstrate the form drag on the stationary solid sphere in moving water.
2. Review the drag coefficient for a smooth sphere.
3. Determine the drag coefficient for a given sphere as a function of Reynolds number.

Experimental Apparatus:

Fully assembled experimental apparatus is show in Fig.1. The apparatus consist of:

(1) Strain gauge (LCFA Series from Omega Company), to measure the drag force on the sphere.
(2) Tank (transparent, ID: 7.5, OD: 8.0, height: 24 inch), containing the water, with fill line and drain pipe connection.
(3) Smooth sphere (diameter =1 inch), suspended from the strain gauge.
(4) Drain pipe (transparent, ID: 2.75, OD: 3.0).
(5) Valve, to control the flow in the drain pipe.
(6) Differential pressure transducer, to measure the water level in the tank.
(7) Real time data acquisition system, to sample the data of the strain gauge and the pressure transducer.

Experiment Procedure:

1. Set up the drag force measuring system according to Fig. 1.
2. Fill the tank with water to about 20 inch high.
3. Connect the output of the strain gauge and pressure transducer to the input of the data acquisition system.
4. Initialize the data acquisition program and run it.
5. Open the valve.
6. Observe the flow in the pipe.
7. Save the sample data of the strain gauge and pressure transducer.

Data Analysis

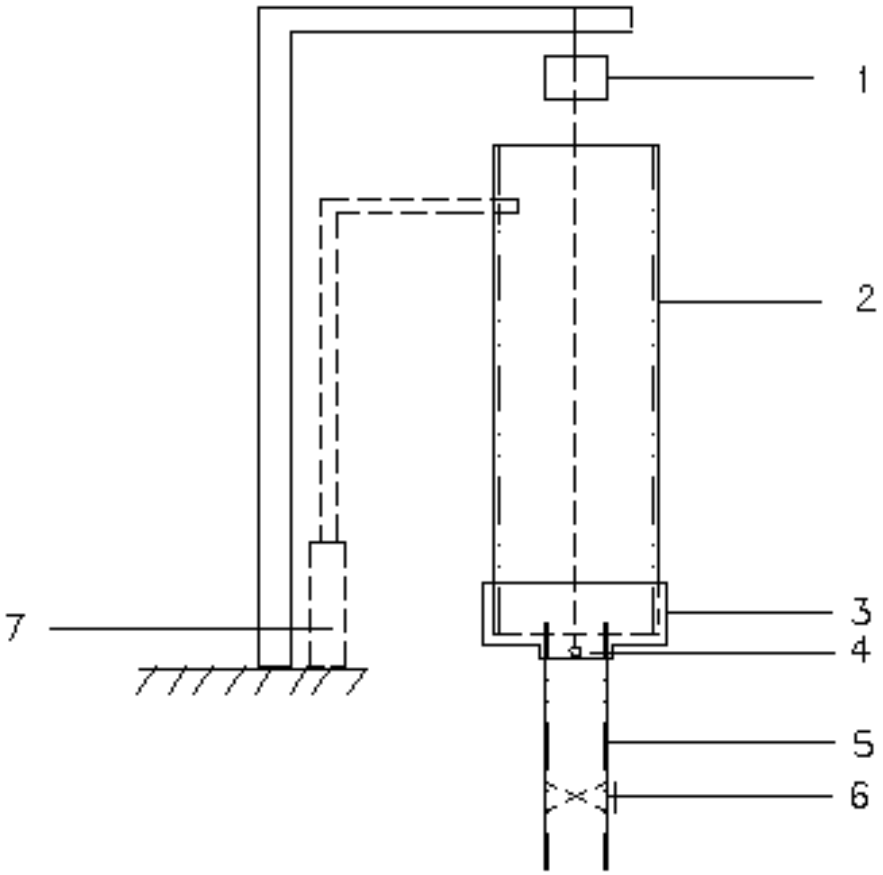
1. From the sample data of the pressure transducer, calculate the water level and the flow rate of the tank.
2. Calculate the velocity of the free stream of the water relative to the sphere.
3. Using $R_e = \frac{V_p D}{\upsilon}$, calculate the Reynolds number.
4. Using $F = C_d(\frac{1}{2}\rho V_p{}^2)A$, calculate the drag coefficient C_d.
5. Plot the value of drag coefficient versus Reynolds number for smooth sphere.
6. Compare this figure to the result in the literature. Analyze the relationship between the drag coefficient and Reynolds number.

Reference

1. Robert W. **Fox,** Alan T. McDonald, *Introduction to fluid mechanics*, New York: Wiley, c1998.

Precautions

1. Center the sphere in the drain pipe. It should be held steady.
2. Don’t disturb the experimental apparatus during the experiment.
3. Don’t spill water on the strain gauge.



1 strain gauge 2 tank 3 flange 4 sphere
5 pipe 6valve 7 pressure gauge

Figure 1. The test facility for the drag force on a sphere.