Ministry of Higher Education and Scientific Research
Al-Mustansiriayah University
College of Engineering
Environmental Engineering Department

وزارةالتعليم العالي والبحث العلمي
الجامعة المستنصرية
كلية الهندسة
قسم هندسة البيئة

Experiment 1
Reynolds Number

Lecturer: Laith Hamdan

اعداد التدريسي : ليث حمدان

Objective:

To perform the Reynolds experiment for determination of different regimes of flow.

Equipments and apparatus:

A stop watch, a graduated cylinder ,and Reynolds apparatus which consists of water tank having a glass tube leading out of it. The glass tube has a bell mouth at entrance and a regulating valve at outlet ,a dye container with an arrangement for injecting a fine filament of dye at the entrance of the glass tube.

Procedure:

1. Fill the water tank with water and allow it to stand for some time so that the water comes to rest.

2. Note the temperature of water.

3. Partially open the outlet valve of the glass tube and allow the flow to take place at a very low rate.

4. Allow the flow to stabilize then open the valves at the inlet of the dye injector and allow the dye to move through the tube. Observe the nature of the filament.

5. Measure the discharge by collecting water in the graduated cylinder for a certain interval of time.

6. Repeat the steps 3 and 5 for different discharges

7. Again note the temperature of water

Theoretical background and Calculation:

$$\mathrm{Re} = \frac{\rho \mathbf{v} D_H}{\mu} = \frac{\mathbf{v} D_H}{\nu} = \frac{\mathbf{Q} D_H}{\nu A}$$

- $\mathbf{D_h}$ is the hydraulic diameter of the pipe; its characteristic travelled length, L, (m).
- $\mathbf{Q}$ is the volumetric flow rate (m^3/s).
- A is the pipe *cross-sectional* area (m^2).
- $\mathbf{v}$ is the mean velocity of the fluid (SI units: m/s).
- μ is the dynamic viscosity of the fluid (Pa·s = N·s/m^2 = kg/(m·s)).
- ν is the kinematic viscosity ($\nu = \mu/\rho$) (m^2/s).
- ρ is the density of the fluid (kg/m^3).

For shapes such as squares, rectangular or annular ducts where the height and width are comparable, the characteristical dimension for internal flow situations is taken to be the hydraulic diameter, D_H, defined as:

$$D_H = \frac{4A}{P},$$

For a circular pipe, the hydraulic diameter is exactly equal to the inside pipe diameter, D. That is,

$$D_H = D.$$

For pipe flow

Re < 2000 – laminar, Re> 4000 – turbulent

For channel flow

Re < 500 – laminar , Re > 2000 – turbulent