Al-Mustaqbal University
College of Engineering and Engineering Technologies
Department of Chemical Engineering and Petroleum Industries

# EXPERIMENTS(4)

# SECOND CLASS

# 1 ND SEMESTER

# FLUID FLOW LABORATORY

**By**

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## Experiment No. (4): *(Reynolds Number)*

## ***Object of Experiment:***

The aim of the experiment is to predict the fluid flow type by determining the Reynolds number.

## ***Theory:***

The Reynolds Number is defined as the ratio of inertial forces to viscous forces in a flowing fluid. It is used in many fluid flow correlations and is used to describe the boundaries of fluid flow regimes (laminar, transitional and turbulent).

There are in general three types of fluid flow in pipes

- laminar
- turbulent
- transient

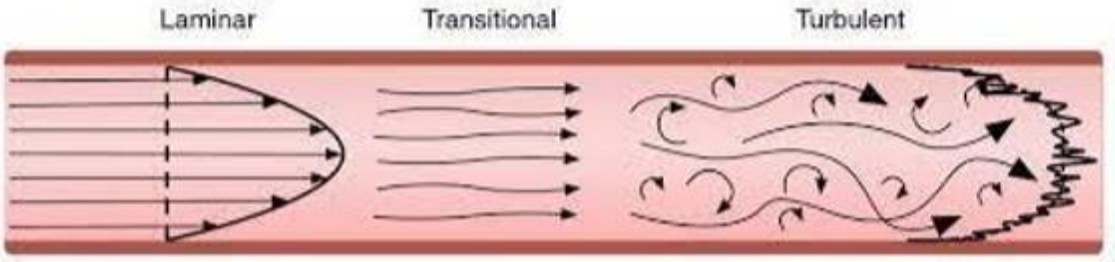
### ***Laminar flow:***

The fluid flow in which the adjacent layers of the fluid do not mix with each other and moves parallel to each other. The laminar flow generally occurs in the fluid flowing with low velocity. The fluid flow is laminar when the value of Reynolds number (Re) is less than 2400. The fluid flow is very orderly i.e. there is no mixing of adjacent layers of the fluid and they move parallel to each other and also with the walls of the pipe.

### ***Turbulent flow***:

The fluid flow in which the adjacent layers of the fluid cross each other and do not move parallel to each other. The turbulent flow occurs when the fluid flows with high velocity. The fluid flow is turbulent when the value of Reynolds number is greater than 4000. The fluid flow is not orderly i.e.

There is mixing of adjacent layers of fluid with each other and they do not move parallel to each other and also with the walls of the pipe. Transitional flow Transitional flow is a mixture of laminar and turbulent flow, with turbulence in the center of the pipe, and laminar flow near the edges. The fluid flow is turbulent when the value of Reynolds number is greater than 2400 and less than 4000




The type of flow can be predicted by determining the dimensionless Reynolds Number

$$\mathbf{Re = (\rho\, V\, d) / \mu}$$

Where: $\rho$: density of water (kg / m3)
$V$: velocity of the fluid (m / sec.)
$V$= Q/A
Q: flow rate = Vol. /t (m3/sec.)
A: area for tube cross-section =π/4 * d2 (m2)
d: the diameter of the pipe (m)
$\mu$: the amount of viscosity (Pa.sec)

## Equipment:

1. Reynolds device.
2. Timer.
3. Tube.
4. Hydraulic desk.

## Procedure of the experiment:

1. Fill the tank with water (a certain volume).
2. Add the dye and gradually open the valve, noting the dye path moving through the water, and increase the flow of water by opening the valve further and observing how the turbulent flow phase begins.
3. Repeat the steps for different discharge with measuring the time required to fill a volume of 150 ml.

## Discussion:

1. What are the differences between laminar and turbulent flow.
2. What is the effect of velocity on viscosity?