



Class: 2nd stage
Subject: Fluid flow



**Ministry of Higher Education and Scientific Research
Al-Mustaqbal University College**

**Chemical engineering and petroleum industries
(Fluid Flow Lab)**

Experiment No. 3

Reynolds number

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Reynolds number

The aim of the experiment:

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

Theoretical part:

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 2100. 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



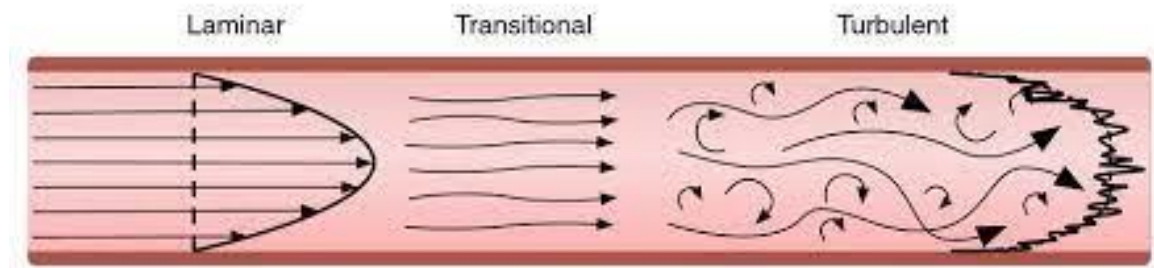
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is mixing of adjacent layers of fluid with each other and they do not move parallel to each other and also with the walls of the pipe.

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 2100 and less than 4000



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

$$Re = (\rho V d) / \mu$$

Where:

ρ : 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 = $\pi/4 * d^2$ (m²)

d : the diameter of the pipe (m)

μ : the amount of viscosity (Pa.sec)



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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.

Results and conclusions:

Find the type of flow for the following readings by determine Reynolds number.

($\rho=1000 \text{ kg / m}^3$, $d=20\text{mm}$, $\text{Vol.}=150\text{ml}$, $\mu=8.9*10^{-4} \text{ Pa}\cdot\text{sec.}$)

No.	Vol. (ml)	t (sec)	Q=Vol./t (m ³ /s)	V=Q/A (m/s)	Re
1	150	30			
2	150	20			
3	150	10			



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Discussion:

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