MID-TERM REPORT ON

VIRTUAL LABS

UNDER THE GUIDANCE OF

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Mtech (CASE-1)



INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY

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(Deemed University)

FLUID-MECHANICS

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EXPERIMENT: 4)REYNOLDS EXPERIMENT

INTRODUCTON:

The purpose of this experiment is to illustrate the influence of Reynolds number on pipe flows. Reynolds number is a very useful dimensionless quantity (the ratio of dynamic forces to viscous forces) that aids in classifying certain flows. For incompressible flow in a pipe

Reynolds number based on the pipe diameter, ReD = VaveDρ/μ, serves well. Generally, laminar flows correspond to ReD < 2100, transitional flows occur in the range 2100 < ReD < 4000, and turbulent flows exist for ReD > 4000. However, disturbances in the flow from various sources may cause the flow to deviate from this pattern. This experiment will illustrate laminar, transitional, and turbulent flows in a pipe.

OBJECTIVE:

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

THEORY:

The flow of real fluids can basically occur under two very different regimes namely laminar and turbulent flow. The laminar flow is characterized by fluid particles moving in the form of lamina sliding over each other, such that at any instant the velocity at all the points in particular lamina is the same. The lamina near the flow boundary move at a slower rate as compared to those near the center of the flow passage. This type of flow occurs in viscous fluids, fluids moving at slow velocity and fluids flowing through narrow passages.

The turbulent flow is characterized by constant agitation and intermixing of fluid particles such that their velocity changes from point to point and even at the same point from time to time. This type of flow occurs in low density

Fluids flow through wide passage and in high velocity flows.

Reynolds conducted an experiment for observation and determination of these regimes of flow. By introducing a fine filament of dye in to the flow of water through the glass tube, at its entrance he studied the different [types](http://theconstructor.org/category/concrete/types/) of flow. At low velocities the dye filament appeared as straight line through the length of the tube and parallel to its axis, characterizing laminar flow. As the velocity is increased the dye filament becomes wavy throughout indicating transition flow. On further increasing the velocity the filament breaks up and diffuses completely in the water in the glass tube indicating the turbulent flow.

After conducting his experiment with pipes different diameters and with water at different temperatures Reynolds concluded that the various parameters on which the regimes of flow depend can be grouped together in a single non dimensional parameter called Reynolds number. Reynolds number is defined as, the ratio of inertia force to the viscous force .Where viscous force is shear stress multiplied area and inertia force is mass multiplied acceleration.

Re=VDρ/ µ =VD/v (v = )

Where

Re-Reynolds number

V -velocity of flow

D-characteristic length=diameter in case of pipe flow

ρ-mass density of fluid = 1000

µ-dynamic viscosity of fluid = 0.55x

v -kinematic viscosity of fluid

Reynolds observed that in case of flow through pipe for values of Re<2000 the flow is laminar while offer Re>40000 it is turbulent and for 2000<Re<4000 it is transition flow.

|  |  |  |
| --- | --- | --- |
| Type of flow | Reynolds number | |
| Pipe flow | canal flow |
| Laminar flow | < 2000 | < 500 |
| Transition flow | 2000 to 4000 | 500 to 2000 |
| Turbulent fllow | > 4000 | >2000 |

[EQUIPMENTS](http://theconstructor.org/category/constrution/equipments-constrution/):

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. Potassium permanganate ( to give brightly reddish color streak),thermometer measuring tank.

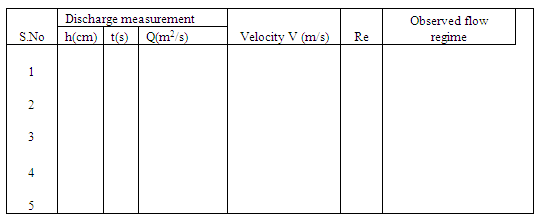
OBSERVATIONS:

Inner diameter of glass tube, D =

Cross - sectional area of glass tube, A = ( π/ 4) x D²

Mean temperature of water – t - =

Kinematic viscosity of water-ν- =



Perform the following calculations for each set of readings

Discharge –*Q*=

Velocity of flow – V=

MANUAL:

Start the experiment by pressing start button with default values of temperature of water and time taken and diameter of pipe. Then pass the experiment with few cycles and note the observation.

Observation1:

1)Start the experiment and allow the water to flow in to the tank of the apparatus. water level in the pyrometer is slightly raising along with rise in tank. Control valve of the glass tube should be slightly opened for removing air bubbles.

2After the tank is filled outlet valve of the glass tube and inlet valve of the tank should be closed, so that water should be at rest.

Observation 2:

1)keeping the velocity of flow is very small and inlet of the die injector is slightly opened, so that the die stream moves at a straight line throughout the tube showing the flow is laminar.

2)Again measure the discharge and increase the velocity of flow.

Observation 3:

1)Note the observations till the die stream in the glass tube breaks up and gets diffused in water.

2)Repeat the experiment by decreasing the rate of flow and by changing the temperature and diameter of pipe.

RESULT:

1) Reynolds number –Re=VD/ ν

2) Regime of flow =

QUIZ:

* Flow to be laminar the Reynolds number should be greater than 2000
* True
* False
* For flow to be turbulent the flow should be more than 400
* True
* False
* Concept of Reynolds number is used in open channels.
* True
* False
* The behavior of path lines is laminar flow.
* True
* False
* If the Reynolds number is in between 2000 and 4000 then the flow is
* Turbulent
* Transition
* Laminar

REFERENCES:

* FLUID MECHANICS- RK BANSAL
* EXPERIMENTS ON FLUID MECHANICS- SARABJIT SINGH
* WIKIPEDIA
* The constructor- <http://theconstructor.org/>

EXPERIMENT: 5)VENTURIMETER

INTRODUCTION:

The Ventura meter used in this experiment consists of successive converging, uniform and diverging sections equipped with pressure taps at selected locations.

A Ventura meter is a device for determining the flow-rate of a fluid down a pipe. One measures the pressure difference between the venture inlet and neck, and from this the flow-rate can be determined.

OBJECTIVE:

To study the variation of Cod and discharge with respect the head by plotting the following graphs

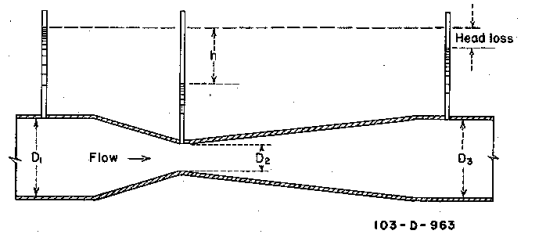
Vs

Vs h

Taking and h on x-axis and on y-axis

THEORY:

Venturimeter is a device used for measuring the rate of flow of a fluid through a pipe. Water is allowed to flow through the meter at different rates ranging from zero to the maximum and the corresponding pressure differences shown in the manometer are noted. The actual discharge A is determined using the measuring tank and the stop watch.



Actual discharge (A)= a x h/t m3/s

Where

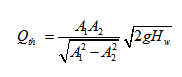
a – Area of measuring tank in cm2

h – Height differences in pyrometer in cm

t – Time to collect water for a height difference of h cm, measured in

Seconds

Theoretical discharge is given by



Where

A1 – The area at inlet side in cm2

A2 – The area at throat in cm2

Hw – Head difference in the manometer, converted to cm of water

g – Acceleration due to gravity (9.81 m/sec²)

Coefficient of discharge is given by

image6.png

OBSERVATIONS AND CALCULATIONS:

Plan area of the tank A =

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Solano | Time for 10cm rise of water level (s ) | | | Actual discharge A. cm3/s | Differential head in cm. of mercury | | | Differential head in cm. of water | Theoretical discharge Qth, cm3/s | Coefficient of discharge Cod |  |
| h1 | h2 | h1- h2  Hug |  |
| t1 | t2 | tm |  |
| 1    2    3    4    5 |  | | |  |  |  |  |  |  |  |  |

MANUAL:

Start the experiment by pressing the start button with keeping default values of inlet die of venturimeter and throat die and rise of water level H and discharge ,then pass the experiment after few cycles and note the observations.

Observations 1:

1)Allow the water to flow from the inlet or gate valve through the pipe to the convergent cone, then the level of the pyrometer rises up to some height.

2)Then the measure the pressure head in the pyrometer.

Observation 2:

1)Then allow the water to flow from the convergent to throat and from the throat to the divergent cone.

2)Then level in the pyrometer rises up to some height. Rising depends upon the rate of flow of water.

Observation 3:

1)Then allow the water to flow in to the collecting through the outlet and after filling some amount of water in the collecting tank ,the water level in the collecting is increased and the measure the time taken to collect the water for every 10cms rise.

2)Repeat the experiment by changing the discharge, inlet die and throat and rise of water level.

###### RESULT: Coefficient of discharge of venturimetre Cod =

###### MAINTENANCE

1. After completing the experiment close the inlet valve and open all the gate valves and needle valves to vent any air trapped inside and then close them.

2. Drain the water from measuring tank after completing the experiment.

QUIZ:

1. venturimeter is used to measure average velocity
2. true
3. false
4. angle of contraction is more than angle of diversion
5. true
6. false
7. The inlet length of the venturimeter s greater than outlet pipe
8. true
9. false
10. Actual discharge is obtained by (A)= a x h/t
11. true
12. False
13. Coefficient of discharge is calculated by =

a)true

b)false

REFERENCE:

1. FLUID MECHANICS- RK BANSAL
2. EXPERIMENTS ON FLUID MECHANICS- SARABJIT SINGH
3. WIKIPEDIA
4. The constructor- http://theconstructor.org/

**6.COEFFFICIENT OF DISCAHRGE OF A WEIR**

**(Broad crested weir)**

**Introduction:** Weirs are concrete or masonry structures used to raise the upstream water level and also as discharge measuring devices. If the width of the crest in the direction of flow is greater than two and half times the head causing flow then the weir is termed as Broad crested weir.

**Objective**: To determine the coefficient of discharge (Cod) of a Broad crested weir.

**Theory:** A weir is an opening in the side walls of a tank. It is same as an orifice without having an outer boundary. If the head is reduced the liquid flows with its level below the top of the orifice. The wall above the liquid level is superfluous and can be removal.

The difference between a large orifice and weir is that liquid flows through the orifice while it flows over the weir. The flow of liquid coming out of orifice is called jet while that comes through the weir is called ‘ nape, sheet or vein.’

There is no difference between a notch and a weir, except that notch is a small structure and has a sharp edges. Weir, on the other hand, is generally is an over flow structure. With broad crested, built across an open channel.

It is built across a river in order to raise water on the upstream and to allow excess water to flow over its entire length to the downstream side. Weirs are used for measuring the rate of flow of water in rivers or stream

The relation between H and h for maximum discharge is, h=

Theoretical discharge, = in m3/sec

Where,

L=Length of the weir measured parallel to width of channel in meters

H=Constant head over the crest on the upstream of channel in meters.

H=(h2-h1).

Actual discharge,=Internal plan area of collecting tank x rise in collecting tank/ time of collection (t) in m3/sec.

Internal plan area of the tank, A = LXB =

Actual discharge, =

T=Time taken for rise of 10cms,

H=Rise of water (10cms)

Then, C0-efficient of discharge = =

**Graph:** Draw a graph between and taking on the x-axis

**Equipment:**

1). A channel or flume to provide a flow passage

2). A broad crested weir.

3).Hook-gauge to measure the head over the crest over the crest of weir.

4). A collecting tank to fitted with a pyrometer, to the discharge over the weir and to find out actual discharge.

5).Stop watch to note the time of collection of water for a known rise of water level in the collecting tank.

6).Meter scale to measure the internal plan dimensions of the collecting tank.

**Manual:**

Start the experiment by pressing start button with default values of length of the collecting -tank, width of the collecting, pause the experiment after few cycles and note the observation.

Observation1:

1).Open the control valve and allow the water level to rise up to the sill level of the weir.

2).Adjust the tip of the hook gauge such that it coincides with water surface and note the reading on hook gauge scale as h1on u/s.

Observation2:

1).operate the control valve such that water flows over the weir to some height.

2). Again adjust the tip of the hook gauge such that it coincides with water surface and note the water level by means of hook gauge as h2.

Observation3:

1).Note the time required for known rise of water level

2).Keeping the length and width of the collecting tank as default values repeat the experiment by adjusting flow of water and hook gauge

**Result:** Average coefficient of discharge of a broad crested weir.

**Quiz:**

1).What is weir? How is different from notch?

2).How is actual discharge of weir measured?

3).Where is broad crested weir is used?

4)Does the magnitude of the flow rate affect the discharge coefficient Cod?

5). Does Cod increases or decrease with increasing flow rate?

6).What is the pattern of the water as its passes over the weir ?

7). Would you expect the length of the weir crest to affect the discharge coefficient Cod?

8). What is the effect of drowning the weir (increasing the downstream depth)?

**Reference**

1. FLUID MECHANICS- RK BANSAL
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3. WIKIPEDIA
4. The constructor- http://theconstructor.org/