

# FLUID FLOW OPERATION LABORATORY

## B. Tech Chemical Engineering

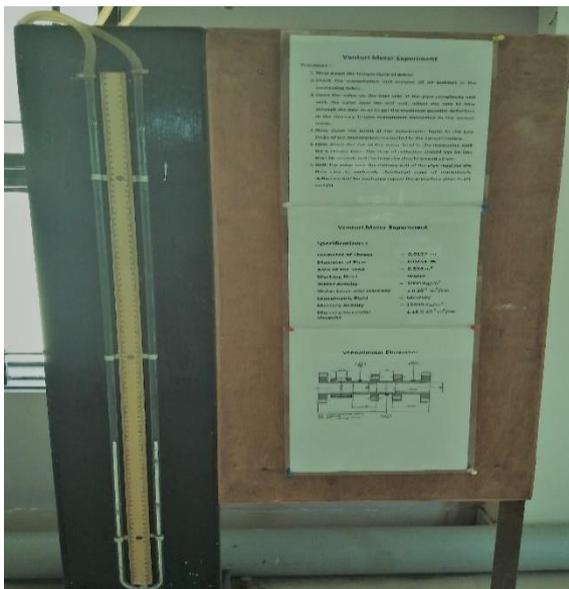
Semester: -4<sup>th</sup>  
Lab No-H-006

### Subject objective: -

A chemical engineer is concerned with the transportation of fluid, both the liquid and gases through piping and all kind of process equipment. This require estimation of pressure drop in the system and hence the power required for piping, selection of suitable type of pumping device, and measurement of the flow rates.

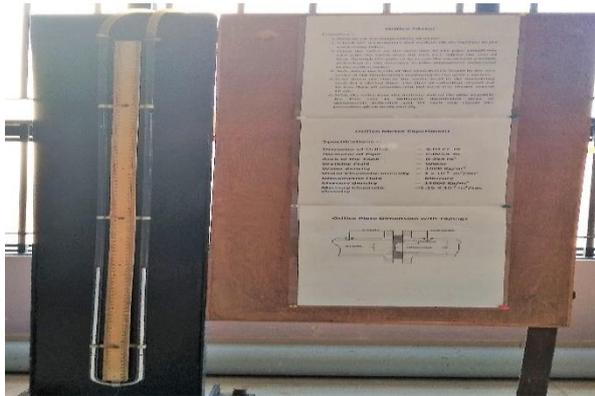
The objective of this laboratory is students are understanding the basic concept of fluid flow and its application to chemical process industries including pipe flow, fluid machinery and measurement and transportation of fluid like determine discharge coefficient of orifice meter, determine discharge coefficient of venturi meter, determine discharge coefficient of rotameter etc.

### Venturimeter



The basic principle on which venturi meter works is that by reducing the cross - sectional area of the flow passage, a pressure difference is created and the measurement of the pressure difference enables the estimation of the discharge/flow rate through the pipe

## Orifice meter



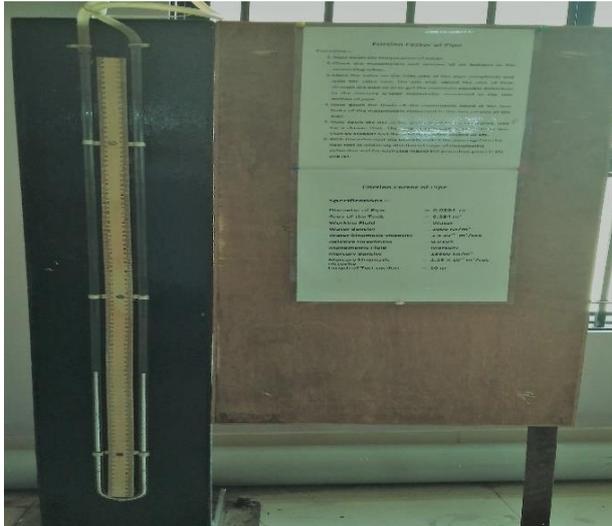
The basic principle on which a orifice meter works is that by reducing the cross-sectional area of the flow passage, the fluid is accelerated and a pressure different is developed, and measurement of the pressure different (between inlet of the meter and a point of reduced pressure) enables the determination of the discharge flow rate through the pipe

## Nozzle meter



The flow nozzle meter is simple in construction and is less costly in comparison with the Venturi meter though it is capable of handling the same discharge as the Venturi meter.

## Fraction factor of pipe



When a fluid flows through a pipe, there is a loss of energy (or pressure) in the fluid. This is because energy is dissipated to overcome the viscous (frictional) forces exerted by the walls of the pipe as well as the moving fluid layers itself. In addition to the energy lost due to frictional forces, the flow also loses pressure as it goes through fittings, such as valves, elbows, contractions and expansions. The pressure loss in pipe flows is commonly referred to as head loss. The frictional losses are referred to as major losses while losses through fittings etc

## Centrifugal head meter



Centrifugal head meter can be used only when the velocity of flow in pipe line is rather high as the differential pressure caused by the primary element is rather

law and at small velocities of flow this differential pressure can be measured accurately. Further at low velocities the co-efficient of discharge of water changes rapidly.

### Rotameter



Rotameter consists of a tapered tube with the smallest diameter at the bottom. The tube contains a freely moving float, which rests on a stop at the base of the tube. When the fluid is flowing, the float rises until its weight is balanced by the up thrust of the fluid, its position then indicating the rate of flow. The pressure difference across the float is equal to its weight divided by its maximum cross-sectional area in a horizontal plane. The area of annulus is the annulus formed between the float and the wall of the tube.

### Flow measurement by notches



A triangular notch is an ordinary plate having a triangular or V-shaped opening and water is discharged through this opening only. For measuring low discharges, a triangular notch is preferred over a rectangular notch. This is because if for a low discharge, a rectangular notch is used, the head over the crest may be so small that it may not be possible to measure it accurately. For such cases a triangular notch is used, because the crest length for V - notch is zero. And even for low discharge, the head over the crest is fairly large which can be measured more accurately.

### Centrifugal pump .



A centrifugal pump is a rotodynamic pump that uses a rotating impeller to increase the velocity of a fluid. Centrifugal pumps are commonly used to move liquids through a piping system. The fluid enters the pump impeller along or near to the rotating axis and is accelerated by the impeller, flowing radially outward into a diffuser or volute chamber, from where it exits into the downstream piping system. It is equally suitable for handling suspension with a high solid content. The centrifugal pump is very wide used in chemical and petrochemical industries

### **Pitot tube**



*Pitot tube is used for determining the local velocity at various points in a pipe.* It consists of an impact tube, which is positioned perpendicular to the direction of flow and a static tube, which is positioned parallel to the direction of flow. One end of the manometer is connected to the impact tube and the other end to the static tube. The resultant difference in manometer level indicates the difference between the sum of kinetic and pressure heads registered by the impact tube and the pressure head as registered by the static tube.

## **Packed bed (Fluidization – gas phase)**



Chemical Engineering operations commonly involve the use of packed beds. These are devices in which a large surface area of contact between a liquid and a gas, or a solid and a gas or liquid is obtained for achieving rapid mass and heat transfer and for chemical reactions. From a fluid mechanical perspective, it is used to determine the pressure drop per unit length of bed

## **Fluidized bed**



Fluidization of a particle bed, it is necessary to determine what range of flow rates allow fluidization, and also, what flow rates will begin to carry the particles out the top of the particle chamber. Extensive use of fluidization in petrochemical industry with the development of fluid catalytic cracking