

Flow Measurement and Instrumentation

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Abstract:-In the physical world, mechanical designers are much of the time required to screen or control the stream of different liquids through funnels, pipes and arranged vessels.. While a few strategies work better with a few gatherings of liquids, and less well with others, some are not in any manner reasonable for a few applications. In this introduction on liquid stream instrumentation we will take a gander at a wide assortment of stream transducers and their application in the physical world. Stream estimation is the measurement of mass Fluid development. Stream can be measured in an assortment of ways. Positive-removal stream meters collect a settled volume of liquid and after that check the quantity of times the volume are filled to quantify stream.

Keywords: Catchphrases: Fluid Stream, Bernoulli's Condition ,Turbulent Flow, Venturimeter, Pitot Tube, Fluid Stream Estimation, Notch Weir ,Nozzle Flow Meter, Hot Wire/Film Tests,

I. INTODURCTION

Industrial stream estimations incorporate measuring of stream rate of solids, fluids and gasses. There are two fundamental methods for measuring stream; one on volumetric premise and the other on weight premise. Strong materials are measured as far as either weight per unit time or mass per unit time. Rarely strong amount is measured as far as volume. Fluids are measured either in Volume rate or in weight rate. Gasses are regularly measured in volume rate. In this part, the stream estimations of fluids and gasses will be examined in detail as opposed to that of solids. Liquids are arranged into two sorts, to be specific incompressible and compressible. Liquids in fluid stage are incompressible while liquids in vaporous stage are compressible. Fluid possesses an indistinguishable volume at various weights where from gasses involve diverse volumes at various weights. This point must be dealt with while aligning the stream meters. The estimations taken at genuine conditions ought to be changed over either to Standard temperature (0°C) and weight (760 mm Hg) base (STP base) or to Normal temperature (20°C) and weight (760 mm Hg) base (NTP base).

II. FLUID FLOW MEASUREMENT

Fluid stream estimation can incorporate a wide variety of fluids and applications. To meet this wide arrangement of employments the instrumentation business has, over various

years, developed a wide collection of instruments. The soonest alluded to uses for stream come as ideal on time as the main recorded history. The out of date Sumerian urban ranges of UR and Kish, near the Tigris and Euphrates streams (around 5000 B.C.) used water stream estimation to manage the flood of water through the repository conductors empowering their urban groups. In this age the direct obstruction was set in the water stream, and by measuring the stature of the water gushing over the most noteworthy purpose of the hindrance, these early draftsmen could choose how much water was spilling. In 1450 the Italian craftsmanship modeler Battista Alberta devised the chief mechanical anemometer. It included a hover put inverse to the breeze, and the energy of the breeze influenced it to rotate. The purpose of inclination of the circle would then show the breeze speed. This was the principle recorded instrument to gage wind speed. An English trend-setter, Robert Hooke reexamined this device in 1709, close by the Mayan Indians around that same time period. Today we would look down our noses at these unpleasant methodologies for stream estimation, yet as you will see, these grungy strategies are as yet being utilized today.

III. TYPES OF FLOW MEASUREMENT DEVICES

Liquid stream gadgets fall into various gadget classifications and in addition liquid classes. When all is said in done we can part the liquids into two classes; gasses and fluids. Inside these two expansive classes are various uncommon classes that one ought to be watchful of. Combustible fluids and gasses require extraordinary taking care of, as do those that are at temperature extremes (icy or hot). While choosing a transducer you ought to be mindful that the gadget you are choosing is good with the liquid and conditions you bunny working with. A couple of illustrations would be acids, sustenance review fluids, and DI water. Shockingly de-ionized water is a to a great degree unforgiving fluid that can cause genuine migraines. The physical estimation gadgets arrive in various characterizations. While the accompanying characterizations don't coordinate any industry norms, they serve to separate the transducers into some sensibly useful gatherings. These are:

- Obstacle stream meters
- Speed stream meters – Including Moving Member meters
- Positive Displacement meters

- Variable range meters
- Electronic meters

We will invest some energy at every class, taking a gander at the specific gadgets that fall into that classification. Some of these gadgets will work with a wide exhibit of liquids, while others have huge confinements. This instructional exercise should enable you to comprehend what these confinements are and when to utilize or not utilize a specific meter.

A. Obstruction Flow Meters

Hindrance stream meters are the simplest and most seasoned of the estimation classes. One of the main check stream meters was utilized by the antiquated Samaritans. With a specific end goal to gauge the measure of water coursing through a reservoir conduit, they would put a board over the stream, and measure how high the water was the point at which it streamed over the highest point of the board. Along these lines they could without much of a stretch figure how much water was streaming in the pipe. This was altered in later circumstances to a gadget called an "indent" weir.

B. Notch weir

Score weirs are grouped by the state of their indent; rectangular weirs; triangular, or V-score, weirs; trapezoidal weirs; and allegorical weirs.



The picture above shows a V-notch weir. The edge the water cascades over is called the crest and the overflowing water sheet is called the nappy. Today weirs are still used to determine flows from open water sources such as streams. A typical 90° V-notch will be beveled at 45° so the edge is less than 0.08” thick and the angle of the notch will be precisely 90°. Water flow over the weir is calculated by the equation:

$$Q=2.49h_1^{2.48} \dots\dots\dots (1)$$

Where

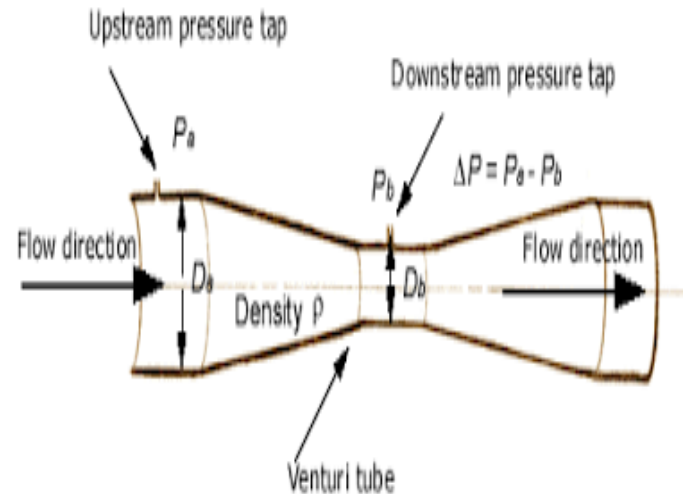
h_1 = head on the weir in ft and

$$Q = \text{discharge over weir in ft}^3/\text{s.}$$

It is easy to see that this is a simple measurement technique can be used on nearly any open flowing body of water. It’s simply a matter of building a large enough weir plate. It is just as obvious that this technique won’t work in an enclosed pipe, and it certainly won’t work for gasses. The measurement of head is the height of the water above the lowest portion of the weir, and should be made at least four times that height, back from the weir.

C. Nozzle Flow Meter

A stream spout comprises of a limitation with a circular shape approach segment that ends in a round and hollow throat segment. Weight drop between the areas one pipe distance across upstream and one-half pipe width downstream is measured. Stream spouts give a middle of the road weight drop between whole plates and wander tubes; likewise, they are material to some slurry frameworks that would be generally hard to quantify



The flow calculations for the long radius nozzle are similar to that of the orifice plate, with the exception of the values of the discharge coefficient. The following table shows some standard values for this value.

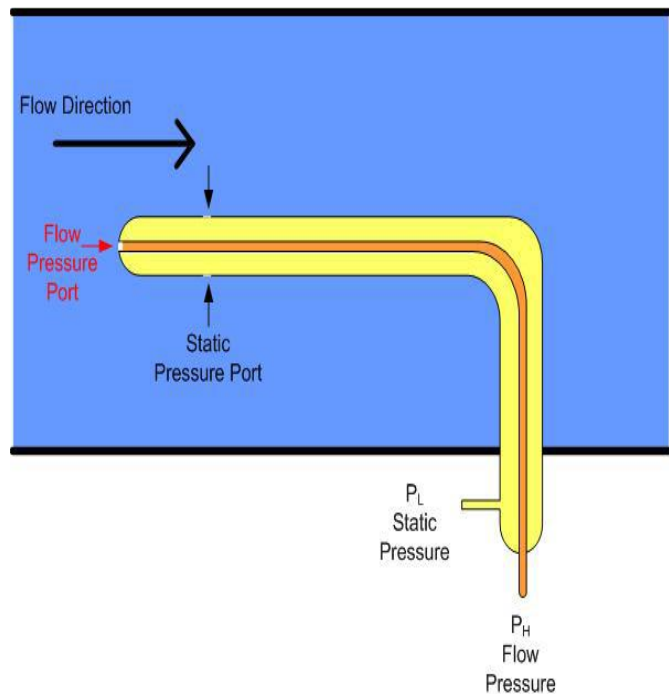
Discharge Coefficient - c_d				
Diameter Ratio d/D	Reynolds Number - Re			
	104	105	106	107
0.2	0.968	0.988	0.994	0.995
0.4	0.957	0.984	0.993	0.995
0.6	0.95	0.981	0.992	0.995
0.8	0.94	0.978	0.991	0.995

D. Velocity Flow Measurement Devices

Speed stream estimation strategies take into account the estimation of aggregate stream by measuring the speed of the liquid inside a settled territory channel or pipe. The method utilizes a measuring test to decide the speed of the liquid in the middle bit of the pipe. It is essential to comprehend that with every liquid stream, there are limit layer impacts at the interface between the dividers of the channel or pipe and the liquid coursing through it. For this method to give sensibly exact outcomes, the speed estimation of the stream must be made well inside the pipe, to limit the impacts of the limit layers. Therefore channels or heaps of little distance across normally don't charge well with this procedure. The system additionally requires that you be in a laminar stream condition. The outcomes in a turbulent stream territory endure in strength and precision. It is conceivable to ascertain the area where the stream in a pipe or channel is completely laminar, yet for most applications a general dependable guideline is adequate. That govern is to influence the estimation no less than 10 to pipe widths upstream and 20 pipe measurements downstream of any intersection, elbow or other stream aggravating point in the pipe.

E. Pitot Tube

The Pitot tube is a straightforward gadget that takes into consideration the estimation of the stream weight in a moving liquid. This gadget is an area of tube that measures the weight at the tip and the weight along the edge of the tube. Perusing this differential weight and applying Bernoulli's condition will take into account the estimation of the liquid speed.



The above graph indicates how the Pitot tube is built of two tubes, one inside the other, to make a static weight port and a stream weight port. Applying Bernoulli's condition we get.

$$P_S + r \left(\frac{v^2}{2} \right) = P_F \dots\dots\dots (2)$$

Where

- r=Density
- V=Velocity
- P_S=Static pressure
- P_F=Flow pressure

If we solve for the velocity we get the following equation:

$$V^2 = 2 \left(\frac{P_F - P_S}{r} \right) \dots\dots\dots (3)$$

This process is extremely useful in locations where there is a significant volume in a large duct or pipe. The differential pressure between the two ports is typically quite small for air flow, and the use of water monometers is a common method of measuring the pressure differential. Small differential pressure transducers are also quite common when an electronic readout is required or desired. Liquid flows can have significantly larger pressure differentials. As with the obstruction flow meters, the fluid that is within the pipe or duct will be on the pressure taps. If this fluid has any nasty properties, you need to take the appropriate steps to protect personnel and equipment. Not all fluids are compatible with all pressure transducers and care must be taken to ensure that an appropriate material is used for all wetted parts.

F. Hot Wire / Film probes

While Pitot tubes work honorably for high stream rates in gasses, and a grouping of stream rates in liquids, the system misses the mark for low velocities in gasses. To light up this gap in speed estimation development, the hot wire and hot film tests were created. This strategy is genuinely straight forward in idea, yet considerably more troublesome in operation. The hypothesis is that on the off chance that you put a resistance wire in the stream of air (or different gas) and warmth the wire with a settled current, the voltage over the wire will demonstrate the resistance of the wire. On the off chance that you know the properties of the wire you can derive what its temperature is. Knowing this data, you can decide how much warmth is being diverted by the moving stream of gas streaming over the wire or film. Straightforward... might be. The trouble with this is the thickness, temperature and real cosmetics of the gas streaming influence the warmth assimilation and in addition the stream. This has been taken care of in various ways, yet the most direct is to utilize two wires. One in the stream a one out of the stream, and make your estimation in view of the distinction of these two esteems. A moment strategy is to make a supposition that the perusing is being made in "standard air" which has a known coefficient of ingestion. Utilizing this technique the main esteems that are required are hot wire esteem and the

temperature of the air before the hot HWire size in the micrometers, the probe can respond to temperature changes at rates faster than 1 millisecond. Makes this type of probe ideal for studies of turbulent flows. Scientific level meters are available from a number of companies that will respond to these high rates of change, but the price is generally in the thousands. Smaller hand held units that respond much slower are available for a few hundred dollars and are a good solution to a low flow application. The accuracy of these devices is typically around 1% or so and is generally designed for use in air, although most can be calibrated for other gasses as well. Another method are measuring the flow velocity in a duct or pipe Is the special class of transducers are called “moving member” meter.

IV. CONCLUSION

Stream Measurement and Instrumentation is committed to dispersing the most recent research comes about on all parts of stream estimation, in both shut conductors and open channels. The plan of stream estimation frameworks includes a wide assortment of multidisciplinary exercises including demonstrating the stream sensor, the liquid stream and the research facility and field appraisal of the general framework under perfect and aggravated conditions sensor/liquid connections using calculation

Procedures; the improvement of cutting edge transducer frameworks and their related flag handling and the. Stream Measurement and Instrumentation is fundamental perusing for instrumentation designs in the oil, gas, control, concoction, sustenance, water and waste treatment enterprises, producers of stream meters, and scholastics engaged with look into here. Shroud full Aims and Scope Measurement and Instrumentation is basic perusing for instrumentation designs in the oil, gas, control, concoction, nourishment, water and waste treatment businesses, producers of stream meters, and scholastics associated with inquire about here.



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