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PROJECT REPORT

2020-2021

DESIGN AND CONSTRUCTION OF ROTAMETER CALIBRATION APPARATUS

Done By:
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Certificate

Certified that this is the *bonafide* Project Report on ....**DESIGN AND CONSTRUCTION OF ROTAMETER CALIBERATION APPARATUS**.....
submitted by..........................**GROUP-1**..........................
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ACKNOWLEGDEMENT

We owe great thanks to many persons who helped and supported us to do this project.

We express our sincere thanks to **Mr. ABDUL NAZAR. A.A,** the Principal of Sree Rama Government Polytechnic College Triprayar, for extending his support.

We express our sincere thanks to **Mr. ABHIJITH S**, Head of the Mechanical Engineering Department for providing with guidance and facilities for the project.

Our deepest thanks to **Mr. JINTO FRANCIS. P.B**, Lecture of Mechanical Department the Guide of Project, for guiding and correcting various documents with attention and care. He has taken pain to go through the project and make necessary correction as and when needed.

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ABSTRACT

This work on basis of literary studies and analysis of the author are examined the principle of action and characteristics of rotameter. Also is shown the procedure for calibrating the rotameter under certain conditions. There have been made some experimental studies on the determination of the calibration curve of the flow meter.

And constructed a rotameter caliberation apparatus and take down the measurement of error happened in the rotameter and analyzed the data theoretically graph is plotted.

Keywords: Rotameter, flow meter, calibration

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CHAPTER 1

INTRODUCTION

1.1 ROTAMETER

Measuring the flow of fluid is a basic need in many industrial plants. In some operations, the ability to conduct accurate flow measurements is so important that it can make a difference between making a profit and taking a loss. In other cases, inaccurate flow measurements or failure to take measurements can cause severe (or even disastrous) results. The Rotameter has many benefits. One example would be the oil industry. If anyone gets a clear idea of exactly how much oil are processing per hour he can estimate the productivity of the plant. That is not the only benefit of this meter. It is also an effective way to keep industrial piping system safe. If the meters are kept calibrated and checked frequently, the authority will be notified before something goes wrong with system, possibly blowing a pipe. In industry it is common to have a piping system for more than one fluids, for example, natural gas and crude oil. This flow meter could easily be inserted into the system and can be monitored very efficiently. Turbine flow meters have been used to measure fluid flow for a wide variety of applications. One type of conventional flow meter utilizes an axial flow turbine that is disposed within a cylindrical bore. As fluid passes through the bore, it impinges upon the vanes of the turbine and cause rotation which is proportional to the rates fluid flow. But in this project a Z axis turbine will be used, which also exhibit similar kind of operation during water impinges.

The amount of a substance (liquid or gas), passing per unit time through a cross-section is called a flow rate. We measure quantity of substance in volume flow Q [m3/s] or mass flow Qm [kg/s]. Devices for measuring the flow (flow rate) are called flow meters. Quantity counters are devices that measure the amount of the substance (fluid) passed through a cross-section per unit time. According to the principle of operation, the flow meters are : variable pressure drop, variable level, with constant pressure drop, velocity, power, electromagnetic, thermal, and others.

The orificemeter, Venturimeter and flow nozzle work on the principle of constant area variable pressure drop. Here the area of obstruction is constant, and the pressure drop changes with flow rate. On the other hand Rotameter works as a constant pressure drop variable area meter. It can be only be used in a vertical pipeline. Its accuracy is also less (2%) compared to other types of flow meters. But the major advantages of rotameter are, it is simple in construction, ready to install and the flow rate can be directly seen on a calibrated scale, without the help of any other device, e.g. differential pressure sensor etc. Moreover, it is useful for a wide range of variation of flow rates (10:1)

The basic construction of a rotameter is shown in fig.. It consists of a vertical pipe, tapered downward. The flow passes from the bottom to the top. There is cylindrical type metallic float inside the tube. The fluid flows upward through the gap between the tube and the float. As the float moves up or down there is a change in the gap, as a result changing the area of the orifice. In fact, the float settles down at a position, where the pressure drop across the orifice will create an upward thrust that will balance the downward force due to the gravity.

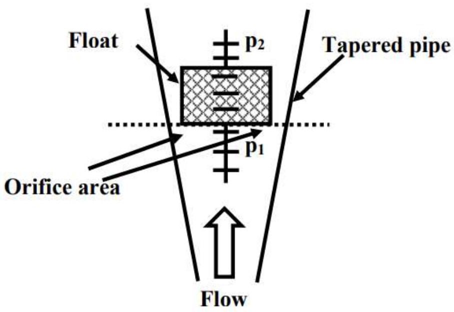


Fig 1.1 Rotameter daigram

The position of the float is calibrated with the flow rate the scale of the tube can be graduated linearly in terms of flow rate. Otherwise, the displacement of the float can be converted to electrical signal by using a LVDT or similar type of displacement sensor. For large flow rate measurement, the rotameter is normally place in a bypass line. The major source of error in rotameter is due to the variation of density of the fluid. Besides, the presence of viscous force may also provide an additional force to the float.

1.2 APPLICATION OF ROTAMETER

- It is used for monitoring filtration loading
- The rotameter is used in process industries
- It is used for monitoring gas and water flow in plants or labs

CHAPTER 2

DESIGN AND WORKING PRINCIPLE

2.1 DESIGN

The Rotameters are one of the most common flow meters. They belong to the group of devices working with a constant pressure drop. Figure 1 shows a principle scheme of a rotameter. Its main elements are a vertically positioned conical transparent tube (1) and float (2). The input of the unit is supplied with fluid (liquid or gas) at a pressure Po. In the absence of flow, when the throttle valve (3) is closed, the float is located in the lower end position, completely closing the tube, and its upper surface should show zero mark on the scale (4). When opening the throttle conditions are created for fluid flow, the flow forces overcoming the weight of the float and move vertically upwards. It opens passage section with an annular space defined by the difference of the diameters of the float and the tube for the particular position of the float. In the actual design the pipe and the scale are interchangeable depending on the scale of the device and the type of measured fluid. Because of the sloping grooves on the flange of the float, the flow giving the latter rotary motion and it centered on the axis of the tube, thereby avoiding friction between solids and improves the sensitivity of the device. Plastic sleeves (5) and (5’) limiting the movement of the float in the end positions and protect the tube from a hard impact at hopping pressure. The vertical position of the pipe is achieved by means of the spirit level (6) and adjustable feet

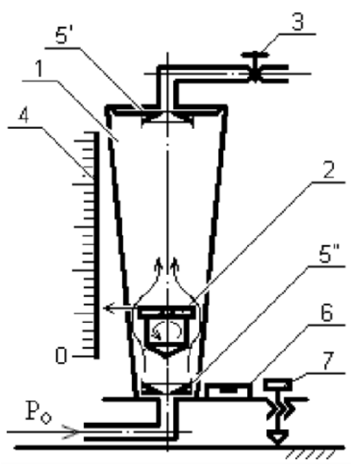


Fig.2.1 Principle scheme of Rotameter

2.2 WORKING PRINCIPLE

The construction drawing of the laboratory Rotameter LD, designed to measure the flow of fluids (liquids and gases), is shown in Fig. In accordance with the principle of operation of the rotameters, a major part of the structure is a vertically extending conical transparent tube (3) with a small cone extending upwards in which a float (15) is placed which, in the absence of flow through the rotameter, under its gravity lies on the plastic sleeve (14) near the lower end of the tube and almost completely closes its light section. When the fluid passes through the pipe in the bottom-up direction, the float is forced to lift, opening a smaller or larger ring gap, depending on the momentary consumption. With a set (constant) flow, the float occupies an equilibrium position along the height of the pipe as determined by its forces. Thus, the height h on which the float is located, measured on a scale on the tube, gives an idea of the flow rate.

The rotameter body consists of two parts – upper (4) and lower (5) heads with central holes and external thread connected to each other by the plate (1). The lower head is attached to the base (2) by screw and a nut (11). To the base are mounted three legs – one non-adjustable (19) and two adjustable (18) by means of which the conical pipe in operation is set vertically to the indications of the circular fluid level (17). The set of the rotameter contains a number of conical tubes of different diametrical dimensions each of which corresponds of a certain measuring range (see Table 1). When installed, the appropriate float is placed inside the selected pipe, in the widened and end portions – plastic sleeves (14), and the nuts (12) and the sealing groups (13), all oriented in the manner shown in the figure, are hopped on the pipe. The tubes are of a length such that they enter a small gap between the heads (4) and (5). With the nuts (12), the sealing groups (13) are tightened to the base, which leads to deformation of the rubber O-rings (6) and (20) and to the sealing of the node. The measured flow is fed to the nozzle (10) (rotor inlet). On its way, the flow meets the conical valve (9), which allows (by rotating the handle (16)) to control the flow. Upon encountering the float (15), the flow raises it andcauses it to rotate due to the unsymmetrical cutout of the surrounding surface of its flange. The purpose of the rotary motion is to entrain a thin layer of fluid that centers the float along the pipe axis and prevents direct contact and friction between them, thereby improving the sensitivity of the device. The purpose of the sleeves (14) is to avoid damaging the pipe and flooding the float in the event of sudden drops in the flow. The upper head (4), by means of the pipe (7), is connected to the nozzle (8) (rotameter outlet). For connection to the inlet and outlet of the rotameter, glands and a flexible hose with inner diameters d are used. When measured, the position of the float (size h) is determined by the float's forehead (surface k) and the conditional scale on the pipe. If necessary, other scales (21) from the set are calibrated for specific fluids and placed on the pipes by means of spring plates. The axial position of these scales is determined according to the benchmarks applied on them and the pipes.

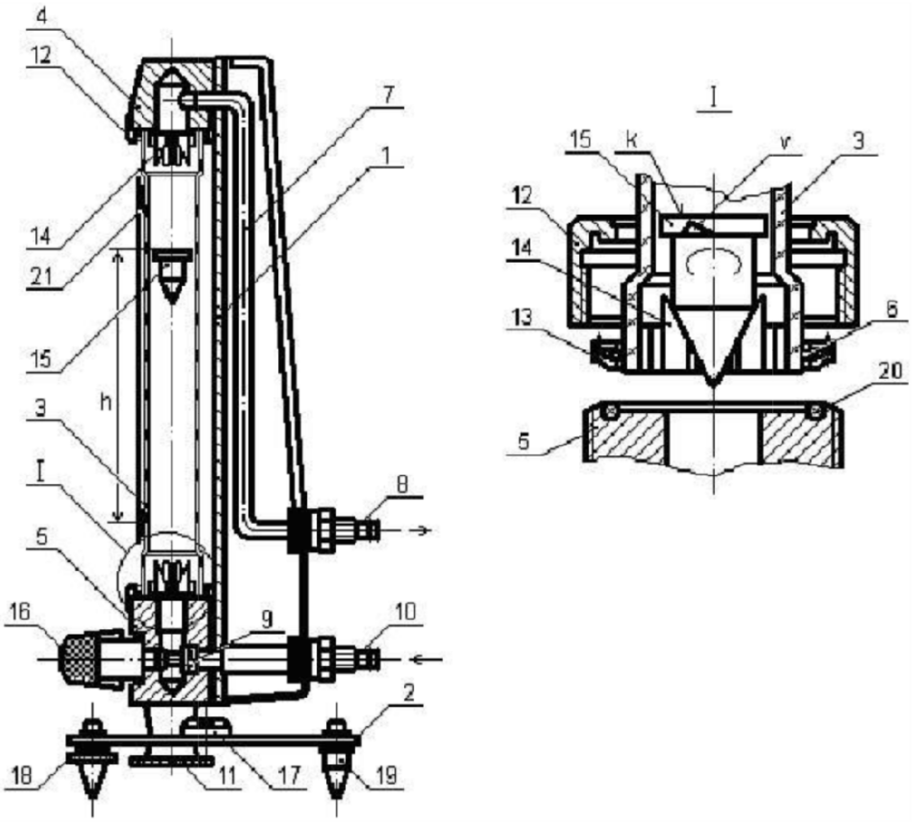


Fig.2.2 Construction drawing of laboratory Rotameter

CHAPTER 3

TYPES OF ROTAMETER

3.1 GLASS TUBE ROTAMETERS

The basic rotameter is the glass tube indicating-type rotameter, which is a basic rotameter, whose tube is formed of borosilicate glass for accuracy, and the float is precisely machined from metal, glass or plastic.

3.2 METAL TUBE FLOW METERS

Metal tubes have a different application from the glass tubes. The metal tubes are used for higher pressure and temperature in the cases where temperatures are above the practical range in which glass tube can be used.

The metal tubes are usually manufactured in aluminum, brass or stainless steel. The piston position is decided based on the magnetic or mechanical follower that can be read from the outside of the metal metering tube. Similar to glass tube rotameters, the spring-and-piston combination determines the flowrate, and the fittings and materials of construction must be chosen in order to satisfy the demands of the applications. The metal meters are used in situations where the high operating pressure or temperature, the water hammer or other forces would be harmful for the glass metering tubes. Spring and piston flow meters can be used for most fluids, including corrosive liquids and gases. They are particularly applicable to steam applications, where glass tubes are unacceptable.

3.3 HEAVY DUTY/INDUSTRIAL PRESSURE TRANSDUCERS

Heavy Duty/Industrial Pressure transducers have a more rough design than other transducers. They are meant to accommodate heavy industrial environments and frequently feature a scalable 4-20 mA transmitter.

This transducer ensures much greater immunity to electrical noise. Such noise is common for industrial environments, but this type of transducer can mitigate the issue.

CHAPTER 4

ACCURACY OF A ROTAMETER

4.1 ACCURACY

Accuracy of 0.50% AR over a 4:1 range can be attained by rotameters when calibrated properly, while the inaccuracy of industrial rotameters is typically 1-2% FS over a 10:1 range. Purge and bypass rotameter errors are in the 5% range. Flow rates can also be set manually through the rotameter by adjusting the valve opening while observing the scale to establish the required process flow rate. Rotameters can be repeatable to within 0.25% of the actual flow rate, only when the operating conditions do not change.

4.2 EFFECT IN ACCURACY

Most rotameters are not influenced by viscosity variations. The most sensitive are very small rotameters with ball floats, while larger rotameters are less sensitive to viscosity effects. The limitations of each design are published by the manufacturer Viscosity limit is influenced by the float shape. If the viscosity limit is exceeded, the indicated flow must be corrected for viscosity. A rotameter can be designed with two floats (one sensitive to density, the other to velocity) so as to approximate the mass flow rate that results from its sensitivity to changes.

The more closely the float density matches the fluid density, the greater the effect of a fluid density change will be on the float position. Mass-flow rotameters work best with low viscosity fluids, such as raw sugar juice, gasoline, jet fuel and light hydrocarbons. Upstream piping configuration does not affect the rotameter accuracy. The meter also can be installed directly after a pipe elbow without adverse effect on metering accuracy. Rotameters are inherently self-cleaning because, as the fluid flows between the tube wall and the float, it produces a scouring action that tends to prevent the buildup of foreign matter.

CHAPTER 5

ADVANTAGES AND DIS ADVANTAGES

5.1 ADVANTAGES

The variable area flowmeter can have a number of advantages. Some advantages of rotameter are stated below.

- It is cheap and easily available in the market.
- It provides a linear scale of measurement. Thus, taking a reading becomes simpler.
- Rotameter is suitable for the measurement of fluids with a velocity of 1 LPM to 10 LPM. In other words, it is suitable for the measurement of fluid with small or medium velocity.
- Even the corrosive fluids can be measured by the rotameter. This is because the metal and the glass cover are highly inert to various kinds of chemicals.
- It provides higher accuracy and precision

5.2 DISADVANTAGES

Even though the rotameter is useful for multiple applications, it has got some drawbacks of its own. So, some of the disadvantages are stated below.

- The outer glass layer can easily break due to fluid pressure. The glass layer can also break during maintenance or transportation of the machine.
- Rotameter should be held upright. If you tilt it, it will cause an inaccuracy during measurement.
- The fluid for which you are planning to measure the velocity should be transparent. Else, you will not be able to see the metering float properly. In that case, you will not be able to take the measurement.
- It is not suitable for fluids having a high velocity.
- If you do not position your eyes to the same level as that of the metering float, then there can be a case of Parallax error.

CHAPTER 6

REVIEW AND METHODOLGY

6.1 LITERATURE REVIEW

In the beginning of 5000 BC measurement of flow was introduced to control water distribution through the ancient aqueducts of the early Sumerian civilization from the Tigris and Euphrates rivers. Such systems were based on volume per time operated by diverting flow in a single direction from dawn to noon and diverted it in another way from noon to dusk. The first milestone in the world of flow technology occurred in 1738 by a Swiss man named Daniel Bernoulli.

In Hydrodynamics, he outlined the basic principles of the conservation of energy for flow. He focused on the reciprocal relation of kinetic energy and static energy which is the basis of differential pressure flow measurement. Until 1790, the concepts of using turbine to measure flow and spinning rotor did not come but a German engineer Reinhard Woltman then developed the first vane type turbine meter to measure flow velocity in river and canals. But those meters were not available in industrial market until World War 2. Emergence of this war created a desire need for equipment of higher accuracy, greater versatility and quicker response under critical conditions. Another milestone occurred in 1832 by Michael Faraday who tried to use his electromagnetic induction laws to measure flow.

To measure the water flow of river Thames, Faraday used two metal electrodes connected to a galvanometer from Waterloo Bridge. Later in 1941, Swiss Benedictine monk Father Bonaventura Thurlemann worked on the method of electrical velocity measurement for liquid and after that in 1962 J. A. Shercliff established firm principles of magnetic flow meters in his book "The theory of electromagnetic flow measurement". Just after three years of Faraday's original experiment, in 1835, Gaspar Gustav de Coriolis made the discovery of coriolis effect which helped to construct the highly accurate direct measurement mass flow coriolis meter later. In 1963 ultrasonic flow meters were first used in commercial application. Before that positive displacement flow meters were common in form. But due to misuse they gained badreputation until further improvements which help them to become world's best. Now the market of ultrasonic flow meter is the quickest growing among all flow meter. In early 1970s Yokogawa developed vortex flow meter which was first introduced by Eastech in 1969. Those flowmeters depend on the creation of vortices generated by a bulk object placed inside flow stream. Although vortex meter are especially for steam measurement but for gas and liquid measurement they can also be used. These have higher accuracy than positive displacement based flow meter. Later in 1997, Sierra Instruments introduced new multivariable vortex flowmeter which was capable to measure more than one process variable and these meters were designed specially including pressure transmitter and a temperature sensor. In 1993, Zierke, Straka and Taylor introduced a high capacity, low noise slip ring in a rotating frame to measure flow where an optical shaft encoder provided rotor angular position and speed. N. R. Kolhare and P. R. Thorat used magnet on one arm of turbine and a Hall Effect device on the outer side of the pipe to measure flow of water in solar water heater in the year of 2013. Last year in October, R. Garmabdari, S. Shafie, A. Garmabdari, H. Jaafar, A. K. Aram used hall effect sensor based rotary encoder to measure algorithm and for monitoring water flow rate. They computed the flow rate by dividing the number of counted pulses (C. P.) over the actual time (Ta) converted to minute which give an output in round per minute (RPM).

6.2 MODERN METHODOLOGY

For this project a standard ARDUINO is used for programming. A turbine with a stainless steel shaft is mounted in a rectangular box. A wheel encoder will be attached with the shaft to count the rotation. The sensor pulses are then sent to the ARDUINO to calculate and store data. The temperature sensor will also take a stream of data that will be sent to the ARDUINO and displayed. The ARDUINO will then use the measurements to calculate the rate of flow &temperature of the material. A digital display will be used as the user interface, showing the data along with simple buttons

CHAPTER 7
PROPOSED METHODS OF CONSTRUCTION

7.1 PLANNING OF CONSTRUCTION OF APPARATUS

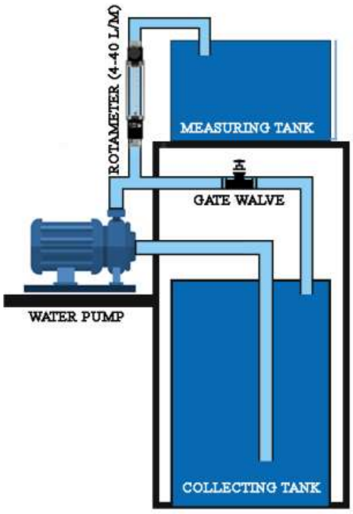


Fig 7.1 Planned Model

The water is collected from collecting tank by suction of electric motor pump and it is bypassed to gate walve and rotameter of specification (4-40 LPM). rotometer is connected vertically in series connection and put water in to measuring tank. Washout and overflow connected and deposited the water in to collecting tank

7.2 MATERIAL REQUIRED

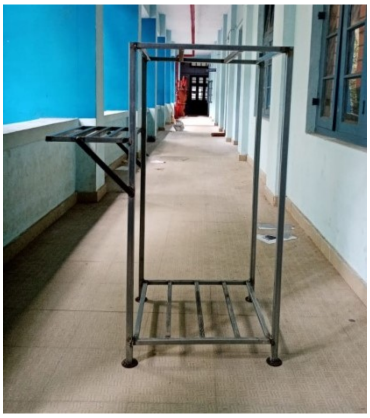
- Electric motor pump(.5 hp,240v)
- Rotameter(4-40 LPM)
- PVC pipe and fittings (1 and .5 inches)
- Collecting tank(100 L Capacity Water can)
- Measuring tank
- Motor fittings

CHAPTER 8

CONSTRUCTION OF ROTAMETER CALIBERATION APPARATUS

8.1 FRAME CONSTRUCTION

The matalic frame of the apparatus is constructed by G I square pipe of 1 inch.With height:125 cm,width :55 cm also there is a stand is weld on the frame for fixing electric motor pump from height of 90 cm



8.2 PLACEMENT OF COLLECTINGAND MEASURING TANK

The collecting tank of capacity 100 L is placed on the bottom side of GI frame and measuring tank of size 25 L is fixed on the upper side of frame. Measuring tank is drilled on frame by the support of wooden reaper.

Collecting Tank

Measuring tank

8.3 FITTING OF ELECTRIC MOTOR PUMP

The electric motor pump of .5hp is fixed on a wooden piece and which is drilled on the GI frame stand. The gasket and flange are fixed on both side of suction and delivery portion. 1 inch hose is heated and fix on the sectional side of electrical motor with help of hose collar.

8.4 PLUMBING AND ELECTRICAL WORK

Plumbing work from suctional side of motor pump is attached by hose and ground valve. From delivery side of electrical motor pump is connected to 1 inch P.V.C pipe and it is connected to the inlet side of rotameter and there is a by pass made for controlling flow of water by using gate valve. From outlet of rotameter is connected to the measuring tank, from measuring tank there is connected by overflow and washout plumbing connection. The electrical work is began with giving electrical supply to motor pump and it is linked with on/off switch

8.5 OVERVIEW OF ROTAMETER CALIBERATION APPARATUS

After the the setting of electric motor pump and other works including plumbing and wiring next step is finishing of the apparatus by using wooden board.

CHAPTER 9

EXPERIMENT ANALYSIS AND RESULT

9.1 FLOW MEASUREMENT BY ROTAMETER

Aim: To calibrate the given rotameter and plot its calibration curve.

Apparatus: The apparatus consists of a fluid circuit which includes sump tank, monoblock pump, rotameter and measuring tank connected in series with the help of pipeline to form a fluid flow circuit. Further, control valves are provided to regulate the flow of water (or any liquid). A stop watch is provided in order to measure the time taken for filling the tank with water up to a specific desired level.

Theory: Rotameter is an instrument used for fluid flow measurement. Rotameter is a variable area flow meter. In head flow meters the restriction size remains constant, due to which the differential pressure across it varies with the differential flow rate through it. But in variable area flow meters the restriction size or flow area of restriction is allowed to vary with the fluid flow rate so as to maintain the differential pressure across it constant. Thus any change in the fluid flow rate can be measured in terms of change of flow area, hence the name variable-area flow meter.

Construction: Rotameter consists of a tapered glass tube mounted vertically with smaller end on lower side. The glass tubes are used for metering low temperature and pressure fluids, but for high temperature and pressure service metal tubes are used. A float is installed in the tube after the meter is mounted in the flow line. Floats are usually made of corrosion resistant metals like aluminum, bronze, monel, nickel, stainless steel etc. Usually a series of slanting notches are cut in the underside of the float rim that gives rotation to float so as to reduce the friction. Float material decides the flow-range of the rotameter. Float may have different float shapes. Flow scale is marked on the glass-tube or it is mounted close to the metering tube. Rotameter is installed in the pipe line by means of flanges or threads alongwith the inlet andoutlet piping supports in brackets. The meter must be installed vertically within about 2 geometrical degrees so as to centre the float in the fluid stream.

Working: When no fluid flows through rotameter float rests at the bottom of the tube. As fluid enters the lower side of the tube, float rises due to buoyant and differential pressure force and allows fluid to flow through annular space between float edge and the metering tube. As fluid flow rate increases, float rises in the tube, thus increasing the flow area keeping differential pressure across it constant. On the other hand as fluid flow rate decreases, float falls in the tube, thus decreasing the flow area with constant pressure drop across the float. At given flow rate, float stabilizers at certain fixed position in the tube. The variation in flow area with fluid flow rate can be measured in terms of change in float position. Thus any change in fluid flow rate through rotameter can be measured in terms of change in float position on the scale calibrated in terms of flow rate.

Procedure:

1. Start the pump.
2. Operate the valve for flow of fluid through rotameter apparatus and keep it slightly open.
3. Slowly adjust the valve so that the flow of fluid through rotameter is sufficient enough so that the float shows displacement.
4. Measure the flowrate of fluid and corresponding float position in rotameter.
5. The flowrate can be calculated by knowing the time taken for filling the tank for a known level. Hence measure the time taken for filling of tank upto a particular level.
6. Increase the flowrate by opening the valve further.
7. Take the reading for different flow rates.
8. Plot a graph of float position vs. flowrate.

OBSERVATION:

1. Length of measuring tank in meters (L) =36 cm
2. Breadth of measuring tank in meters(B)=26cm
3. Height (level) in piezometer tube of measuring tank in meter which is under consideration (Z)=10 CM

9.2 EXPERIMENT NO: 1

OBSEVATION TABLE-1

Obs. No.	**Rotameter Reading**	**Measuring Tank Reading**	**Time**	**Actual Flow Rate**	**Difference in flow rate (error)**	**%error**
	Q_{ar}	z	t	Q_a	$(Q_a - Q_{ar})$	$((Q_a - Q_{ar})/Q_a) \times$
	LPM	CM	S	LPM	m^3/s	%
1	12	10	48	11.7	-0.3	2.56%
2	14	10	41	13.69	-0.31	2.26%
3	16	10	35	16.04	0.04	.24%
4	18	10	30	18.11	0.11	.60%
5	20	10	28	20.05	.05	.24%

Table 9.2 Observation table 1

$$ACTUAL\ FLOW\ RATE\ (Q_a) = \frac{volume}{time} = \frac{L \times B \times Z \times 60}{t \times 1000}\ LPM$$

Where,

L = Length of measuring tank in meters,

B = Breadth of measuring tank in meters,

Z = Height (level) in piezometer tube of measuring tank in meter which is under consideration

t = time taken for filling of water in tank till decided height in seconds, say for ‘Z’ mm

SAMPLE CALCULATION

<u>Set no:1</u>

1)Length of measuring tank in meters (L) =36 cm

2)Breadth of measuring tank in meters(B)=26cm

3) Height (level) in piezometer tube of measuring tank in meter which is under consideration (Z)=10 CM

4)$ACTUAL\ FLOW\ RATE\ (Q_a) = \frac{volume}{time} = \frac{L \times B \times Z \times 60}{t \times 1000}\ LPM$

$= \frac{36 \times 26 \times 10 \times 60}{48 \times 1000} = 11.7\ LPM$

5)$error = (Actual\ flowrate - rotameter\ reading) = (Q_a - Q_{ar})$

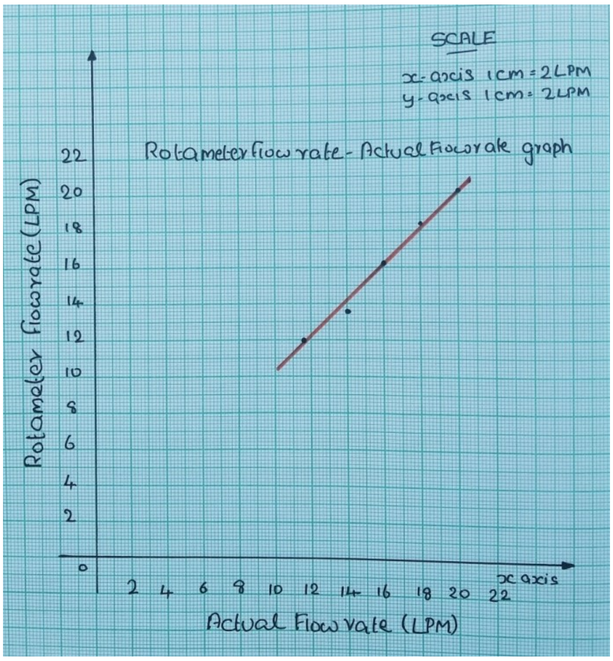
=(11.7-12)= -0.3

6) $error = \frac{(Actual\ flowrate - rotamete\ \ reading)}{Actual\ flowrate} \times 100 = \frac{(Qa- \quad)}{Q_a} \times 100$

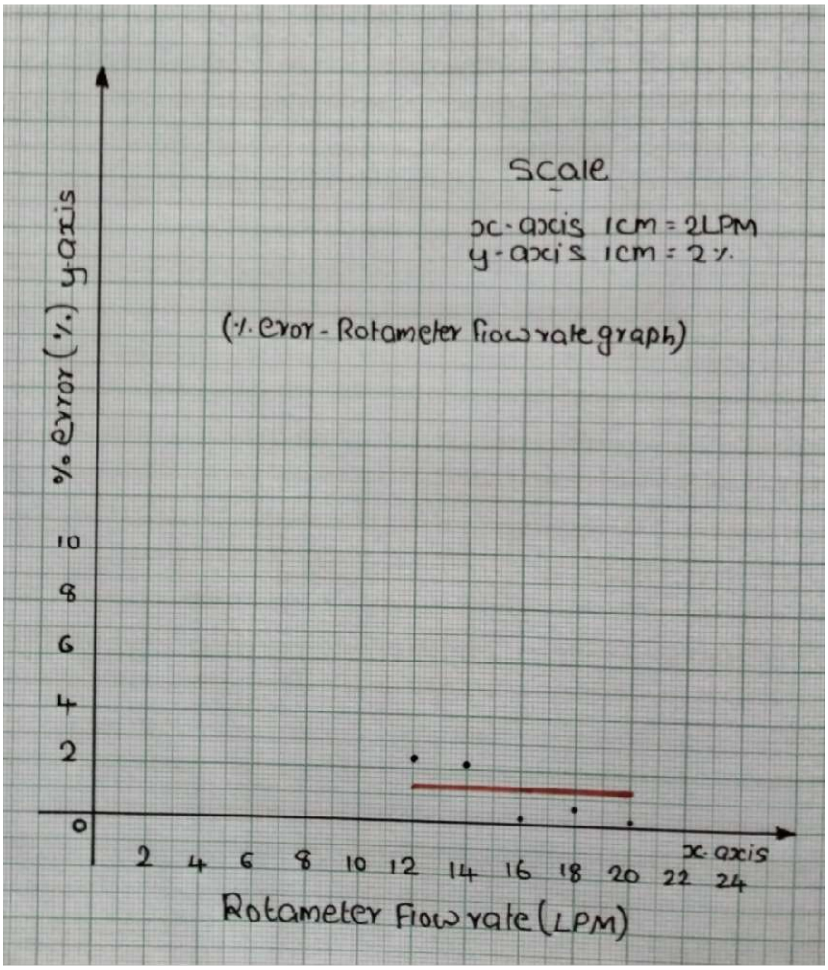
$= \frac{.3}{11.7} \times 100 = 2.56\%$

PLOTTING OF GRAPH

<u>Rotameter Flowrate-Actual flowrate graph(graph no: 9.2)</u>



%Error-Rotameter flowrate graph(graph no:9.2)



Result:

Error in 12 LPM=2.56%

Error in 14 LPM=2.26%

Error in 16 LPM=0.24%

Error in 18 LPM=0.60%

Error in 20 LPM=0.24%

Conclusion:

Experiment conducted and observed the eror in measurement of caliberation of rotameter apparatus

9.3 EXPERIMENT NO: 2

Obs. No.	Rotameter Reading	Measuring Tank Reading	Time	Actual Flow Rate
	Q_{ar}	z	t	Q_a
	CM	CM	S	cm^3/s
1	4.5	10	39	14400
2	5	10	36	15600
3	5.5	10	32	17550
4	6	10	29	19365
5	6.5	10	26	21600

OBSERVATION TABLE-2

Table 9.3 Observation table 2

$$ACTUAL\ FLOW\ RATE\ (Q_a) = \frac{volume}{time} = \frac{L \times B \times Z \times 60}{t} cm^3/s$$

Where,

L = Length of measuring tank in meters,

B = Breadth of measuring tank in meters,

Z = Height (level) in piezometer tube of measuring tank in meter which is under consideration

t = time taken for filling of water in tank till decided height in seconds, say for ‘Z’ mm

SAMPLE CALCULATION

Set no:1

1)Length of measuring tank in meters (L) =36 cm

2)Breadth of measuring tank in meters(B)=26cm

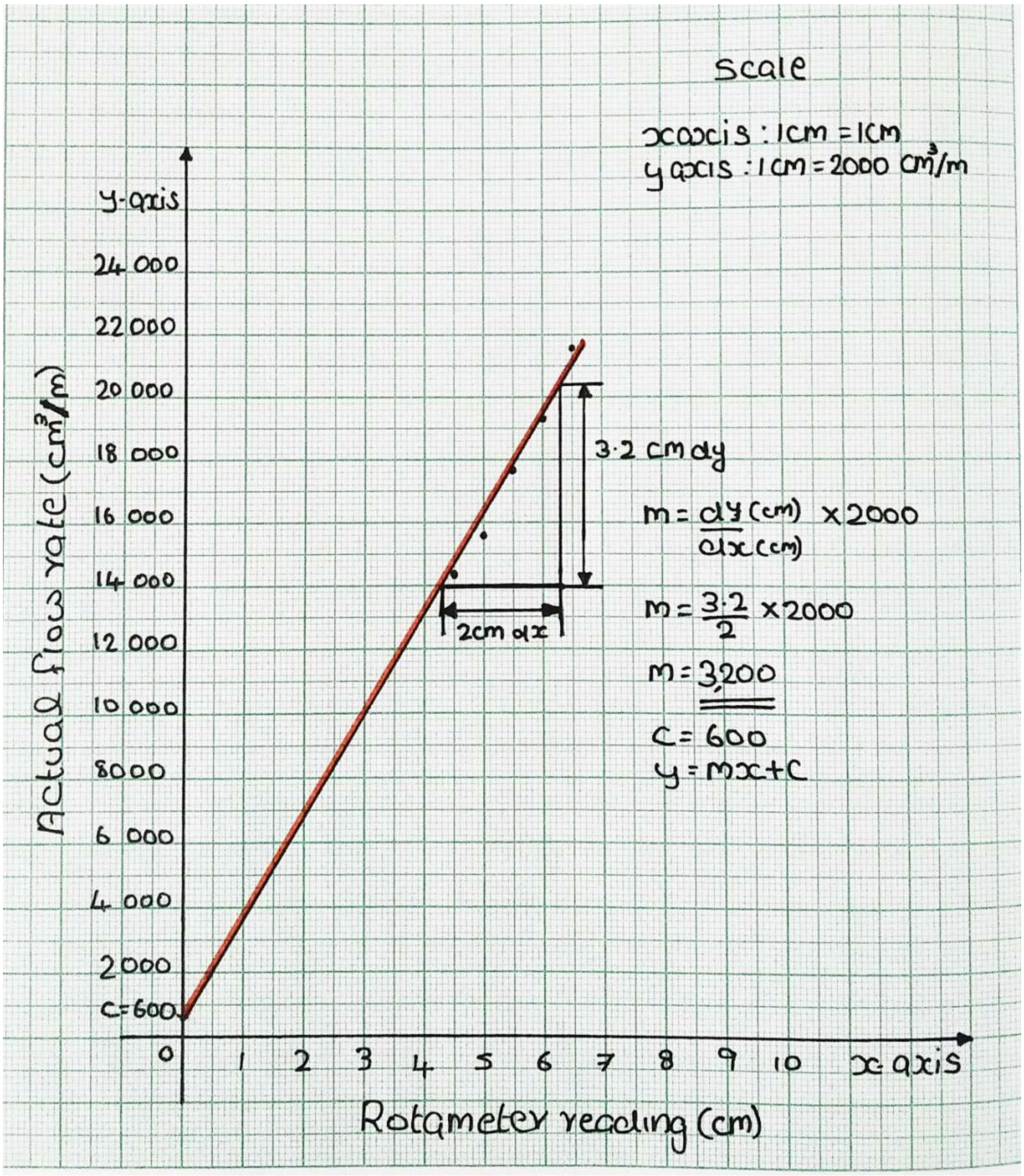
3) Height (level) in piezometer tube of measuring tank in meter which is under consideration (Z)=10 CM

4) $ACTUAL\ FLOW\ RATE\ (Q_a) = \frac{volume}{time} = \frac{L \times B \times Z \times 60}{t} cm^3/s$

$$= \frac{36 \times 26 \times 10 \times 60}{39} = 14400 cm^3/s$$

PLOTTING OF GRAPH

<u>Actual flowrate-Rotameter reading graph(graph no:9.3)</u>



CALIBERATION CHART

VALUE OF ROTAMETER	DISCHARGE $y = mx + c$ $m = 3200; c = 600$
X(cm)	cm^3/s
1	3800
2	7000
3	10,200
4	13,400
5	16,600
6	19,800
7	23,000
8	26,200
9	29,400
10	32,600
11	35,800
12	39,000
13	42,200
14	45,400
15	48,600

Table 9.3 Caliberation chart

Result: Caliberation chart is prepared and graph plotted

CHAPTER 10

CONCLUSION

The purpose of this work is to shown one of the methods for calibration of the rotameters. There are some results from these experiments. Noted the error in caliberation of rotameter by analyzing data through manual reading. Another experiment is done and rise of ball in rotameter is noted ,Calibration curve for the rotameter is linear model. It also shows that the replicated points show very little deviation.Also to prepared caliberation chart through the experiment of reading cm scale and find the discharge in each centimeter.

PHOTO GALLERY

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