NATIONAL UNIVERSITY
MF Jhocson Street, Sampaloc, Manila
DEPARTMENT OF CIVIL ENGINEERING
HYDRAULICS LABORATORY

LABORATORY ACTIVITY # 2

DISCHARGE MEASUREMENT USING MEASURING TANK

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NAME: DATA, MOLON, PORLARES, TRANSFIGURACION DATE: MAY 07, 2021

GROUP #: 3 SECTION: CIVP14

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DISCHARGE MEASUREMENT USING MEASURING TANK

I. INTRODUCTION:

In the study of fluid dynamics and hydraulics, discharge and flow rate are relevant topics. Flow measures are also used in the metering of water in our daily lives. The flow measuring apparatus is used to familiarize students with flow measurement methods in a fluid. It is essential to know whether flows are low, moderate, or vigorous and whether they are rising or dropping. To measure discharge, you must have a working knowledge of measuring instruments or apparatus. [1] The amount of fluid flowing through the measuring tank is calculated. The fluids include knowing how much liquid is stored in a tank at any given time A flow rate of water is measured with the help of a measuring tank and stopwatch.

The discharge is also called flow rate. Flow rate Q is defined as the volume of fluid passing by some location through an area where *V* is the volume and *t* is the elapsed time the SI unit for the flow rate is (m3/s). Flow rate and velocity are related, but quite different, physical quantities. The precise relationship between flow rate *Q* and velocity *v* is *Q=Av. A* is the cross-sectional area, and *v* is the average velocity. Discharge is also expressed as mass flow rate and weight flow rate. That is, flow rate multiplied by density or unit weight, respectively. [3]

Flow volume and velocity are often compared. The rate of flow increases as the cross-section or size of the decreases, and decreases as the cross-section or size increases, with the amount of input remaining constant. The flow rate is slower in broader streams and faster in narrower streams, but the amount of fluid flowing through each segment is the same. [4]

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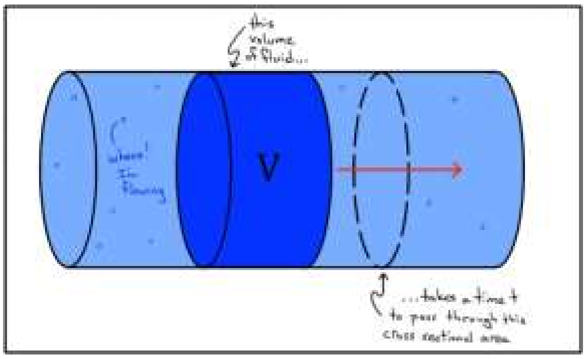
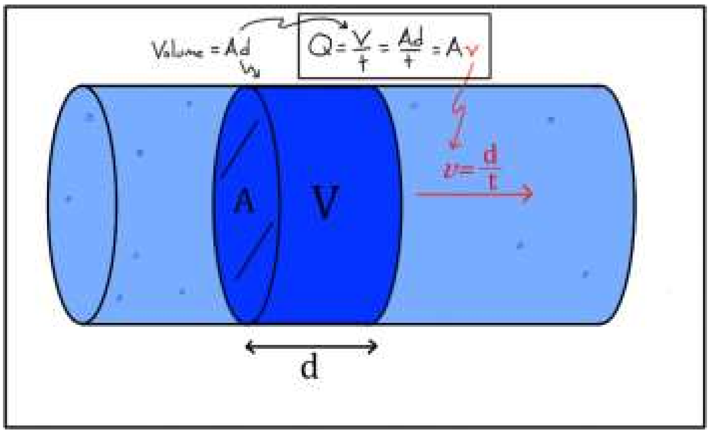
$$Q = \frac{V}{t}.$$



$$Q = \frac{V}{t} = \frac{Ad}{t} = A\frac{d}{t}$$

$$Q = Av$$



Where:

Q = discharge in m3/sec or ft3/sec
V = volume of fluid (m3)
t = time (s)
A = cross-sectional area of flow in m2 or ft2
v = mean velocity of flow in m/sec or ft/sec
ρ = mass density of the fluid in kg/m3 or slugs/ft3
γ = unit weight of fluid in N/m3 or lb/ft3

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II. OBJECTIVES:

1. To be able to familiarize on how to measure discharge by means of measuring tank.
2. To know how to use simple and proper devices in measuring discharge of fluids that can be done even at home.
3. To be able to understand the relationship between volume per unit time, how other factors involved affects flow rate of fluid.

III. NEEDED APPARATUS:

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1. **Beaker -** proper as a reaction container or to hold solid and liquid samples. [5]

2. **Stopwatch –** a device used to measure time.[6]

3. **Glass funnel -** A funnel is a tube or pipe that is wide at the top and narrow at the bottom, used for guiding liquid or powder into a small opening.[7]

4. **Retort Stand** - also called a clamp stand, a ring stand, or a support stand, is a piece of scientific equipment intended to support other pieces of equipment and glassware. [8]

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IV. PROCEDURE:

1. Prepare all the needed apparatus, devices and fluids needed in the experiment.
2. Clamp the funnel in a retort stand. Put a beaker underneath the set up.
3. Fill 250 mL of fluid 1 to the measuring tank.
4. Block the waterway/canal of the funnel with a thumb finger.
5. Pour the fluid in the measuring tank to the funnel.
6. Release thumb finger and start the timer at the same time.
7. Stop the timer after the fluid flows down fully to the beaker underneath.
8. Record and gather required data.
9. Repeat the process from 3 – 8 with another fluid.

Please refer to following video link:

https://www.youtube.com/watch?v=tCIBM1-HkdY

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V. DATA & RESULTS

FLUID	Mass (Kg)	Weight (N)	Volume (m^3)	Specific Weight (kN / m^3)	Flow Rate (m^3/s)	Time (s)	Velocity (m/s)
Water	0.2471	2.42405	0.00025	9.696204	0.0000806	3.1	1.267667
Soy Sauce	0.3088	3.02933	0.00025	12.117312	0.0000756	3.307	1.188318
Vinegar	0.2979	2.9224	0.00025	11.689596	0.0000639	3.91	1.005056
Fish Sauce	0.2979	2.9224	0.00025	11.689596	0.0000765	3.27	1.201764
Oil	0.2294	2.25041	0.00025	9.001656	0.0000341	7.34	0.535391
Diesel	0.2053	2.01399	0.00025	8.055972	0.0000774	3.23	1.216646
Gasoline	0.2019	1.98064	0.00025	7.922556	0.00006	4.17	0.94239
Kerosene	0.2984	2.9273	0.00025	11.709216	0.0000774	3.23	1.216646
Unleaded	0.1875	1.83938	0.0001	18.39375	0.000073	1.37	1.147377
Motor Oil	0.2057	2.01792	0.00025	8.071668	0.0000091	27.42	0.143318
Diesel Engine	0.2145	2.10425	0.00025	8.41689	0.0000088	28.53	0.137742

VI. COMPUTATION

$Note\ that: 1Kg = 9.81N$

$Mass \rightarrow Weight$

$W_{Water} = (0.2471)(9.81) = \mathbf{2.424051\ N}$

$W_{SoySauce} = (0.3088)(9.81) = \mathbf{3.029328\ N}$

$W_{Vinegar} = (0.2979)(9.81) = \mathbf{2.922399\ N}$

$W_{FishSauce} = (0.2979)(9.81) = \mathbf{2.922399\ N}$

$W_{Oil} = (0.2294)(9.81) = \mathbf{2.250414\ N}$

$W_{Diesel} = (0.2053)(9.81) = \mathbf{2.013993\ N}$

$W_{Gasoline} = (0.2019)(9.81) = \mathbf{1.980639\ N}$

$W_{Kerosene} = (0.2984)(9.81) = \mathbf{2.927304\ N}$

$W_{Unleaded} = (0.1875)(9.81) = \mathbf{1.839375\ N}$

$W_{MotorOil} = (0.2057)(9.81) = \mathbf{2.017917\ N}$

$W_{DieselEngine} = (0.2145)(9.81) = \mathbf{2.104245\ N}$

$\mathbf{Volume = 250\ ml = 0.00025\ m^3}$

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All of fluid filled up the measuring tank up to 250 ml except Unleaded Oil (100ml)

Specific Weight (kN/m^3) $\rightarrow \gamma = (0.001)\ (\boldsymbol{W} / V)$

$$\gamma_{Water} = (0.001)\left(\frac{2.424051}{0.00025}\right) = \mathbf{9.696204\ kN/m^3}$$

$$\gamma_{SoySauce} = (0.001)(\frac{3.029328}{0.00025} = \mathbf{12.117312\ kN/m^3}$$

$$\gamma_{Vinegar} = (0.001)\left(\frac{2.922399}{0.00025}\right) = \mathbf{11.689596\ kN/m^3}$$

$$\gamma_{FishSauce} = (0.001)\left(\frac{2.922399}{0.00025}\right) = \mathbf{11.689596\ kN/m^3}$$

$$\gamma_{Oil} = (0.001)\left(\frac{2.250414}{0.00025}\right) = \mathbf{9.001656\ kN/m^3}$$

$$\gamma_{Diesel} = (0.001)\left(\frac{2.013993}{0.00025}\right) = \mathbf{8.055972\ kN/m^3}$$

$$\gamma_{Gasoline} = (0.001)\left(\frac{1.980639}{0.00025}\right) = \mathbf{7.922556\ kN/m^3}$$

$$\gamma_{Kerosene} = (0.001)\left(\frac{2.927304}{0.00025}\right) = \mathbf{11.709216\ kN/m^3}$$

$$\gamma_{Unleaded} = (0.001)\left(\frac{1.839375}{0.0001}\right) = \mathbf{18.39375\ kN/m^3}$$

$$\gamma_{MotorlOil} = (0.001)\left(\frac{2.017917}{0.00025}\right) = \mathbf{8.071668\ kN/m^3}$$

$$\gamma_{DieselEngine} = (0.001)\left(\frac{2.104245}{0.00025}\right) = \mathbf{8.41689\ kN/m^3}$$

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Flowrate or Discharge (m^3/s) → ***Q=V/t***

$$Q_{water} = \frac{0.00025}{3.1} = \mathbf{0.0000806\ m^3/s}$$
$$Q_{SoySauce} = \frac{0.00025}{3.307} = \mathbf{0.0000756\ m^3/s}$$
$$Q_{Vinegar} = \frac{0.00025}{3.91} = \mathbf{0.0000639\ m^3/s}$$
$$Q_{FishSauce} = \frac{0.00025}{3.27} = \mathbf{0.0000765\ m^3/s}$$
$$Q_{Oil} = \frac{0.00025}{7.34} = \mathbf{0.0000341\ m^3/s}$$
$$Q_{Diesel} = \frac{0.00025}{3.23} = \mathbf{0.0000774\ m^3/s}$$
$$Q_{Gasoline} = \frac{0.00025}{4.17} = \mathbf{0.0000600\ m^3/s}$$
$$Q_{Kerosene} = \frac{0.00025}{3.23} = \mathbf{0.0000774\ m^3/s}$$
$$Q_{Unleaded} = \frac{0.0001}{1.37} = \mathbf{0.0000730\ m^3/s}$$
$$Q_{MotorOil} = \frac{0.00025}{27.42} = \mathbf{0.0000091\ m^3/s}$$
$$Q_{DieselEngine} = \frac{0.00025}{28.53} = \mathbf{0.0000088\ m^3/s}$$

Velocity (m/s) $\rightarrow \boldsymbol{V} = \frac{\boldsymbol{Q}}{\boldsymbol{A}}$; *Cross-sectional Area of the Cylinder = 3.9297677* m^2

$$V_{Water} = \frac{0.0000806}{3.9297677} = \mathbf{1.267667\ m/s} \qquad V_{DieselEngine} = \frac{0.0000088}{3.9297677} = \mathbf{0.137742\ m/s}$$

$$V_{SoySauce} = \frac{0.0000756}{3.9297677} = \mathbf{1.188318\frac{m}{s}} \qquad V_{Gasoline} = \frac{0.0000600}{3.9297677} = \mathbf{0.94239\ m/s}$$

$$V_{Vinegar} = \frac{0.0000639}{3.9297677} = \mathbf{1.005056\frac{m}{s}} \qquad V_{FishSauce} = \frac{0.0000765}{3.9297677} = \mathbf{1.201764\ m/s}$$

$$V_{Oil} = \frac{0.0000341}{3.9297677} = \mathbf{0.535391\frac{m}{s}} \qquad V_{Diesel} = \frac{0.0000774}{3.9297677} = \mathbf{1.216646\ m/s}$$

$$V_{Kerosene} = \frac{0.0000774}{3.9297677} = \mathbf{1.216646\frac{m}{s}} \qquad V_{Unleaded} = \frac{0.0000730}{3.9297677} = \mathbf{1.147377\ m/s}$$

$$V_{Unleaded} = \frac{0.0000730}{3.9297677} = \mathbf{1.147377\frac{m}{s}} \qquad V_{MotorOil} = \frac{0.000001}{3.9297677} = \mathbf{0.143318\ m/s}$$

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VII. CRITIC GUIDE QUESTIONS

1. How can discharge be measured using a measuring tank?
2. What are the different factors that affect the discharge of a fluid given that they have the same volume during experimentation?
3. What happens to the value of the discharge when the volume is increased?
4. How does the property of the fluid in experimentation affect its discharge?

Answer to Critic Guide Questions:

1. How can discharge be measured using a measuring tank?

   Two ways to measure the discharge using a measuring tank, Theoretical discharge, and Actual discharge. Theoretical is from our computation using formula of discharge which is Q=volume/time using this formula we can calculate the discharge coefficient while Actual discharge or the flow meter reading is the actual reading of hydraulic bench.

2. What are the different factors that affect the discharge of a fluid given that they have the same volume during experimentation?

   Discharge is not only volume based, but there are other factors that can affect the discharge of fluid. One factor of it is property of liquid. Viscosity or the thickness of the fluid this affects the flow. A fluid that is highly viscous has a high resistance it flows slower than the low viscous fluid. Another factor is the inner diameter, length, internal roughness, entrance and exit of the pipe where fluid flows. Also, change in temperature will change the viscosity and the density of the liquid.

3. What happens to the value of the discharge when the volume is increased?

   Discharge is directly proportional to area multiplied to velocity, which means if the volume increased, the value of discharge also increases. As discharge increase, width, velocity, and depth also increases.

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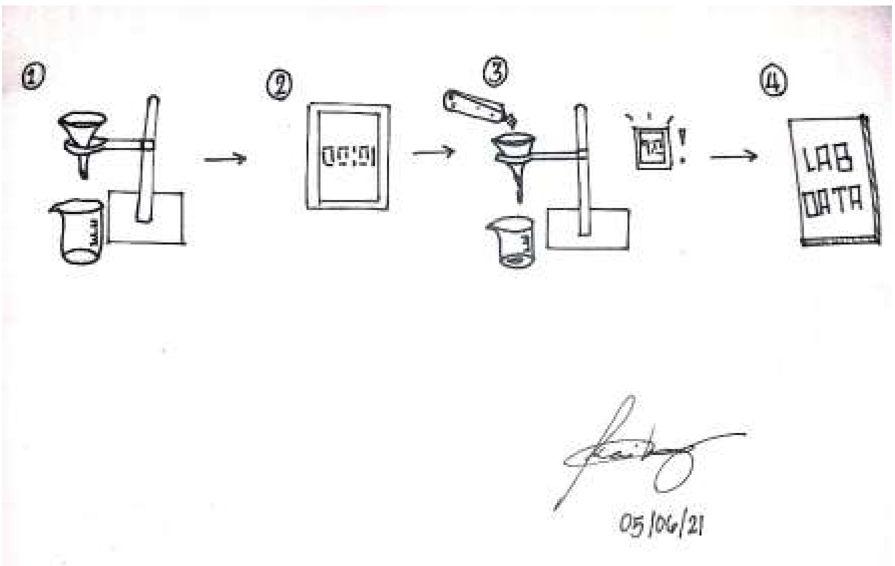
4. How does the property of the fluid in experimentation affect its discharge?
   Time duration of the discharge is affected by the property of the fluid. The higher the viscous, the slower the discharge rate. A low viscous fluid flow faster than a highly viscous fluids because it has high resistance for its surroundings.

VIII. LABORATORY SET-UP

Draw a schematic of the laboratory set-up. Include the label of the different apparatus that were used. Narration of the methodology/procedure is highly encouraged.



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IX. OBSERVATION AND CONLCUSION:

The aim of this experiment was to learn how to use the process and how to measure discharge using a measuring tank. We can measure the discharge through actual discharge also known as flow meter reading and theoretical discharge. Also, by this experiment, we have learned that measuring discharge of fluids can be done even at home.

We concluded that time is a factor that affects the value of discharge since the volume of the fluids are constant. Time of flow depends not only in volume but also in fluid property. The property of this fluid is called viscosity. Viscosity plays a big role to the time of fluid to flow. When the viscosity of a fluid is higher, the higher the time of flow and when the viscosity of a fluid is lower, the lower the time of flow. Also, we've noticed that the difference between the actual and theoretical discharge is just minimal. If there's a large difference between the two, there's a possibility that the data gathered is inaccurate or the process was not followed properly.

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