

Palestine Technical University – Khodoori

College of Engineering and technology

Department of Mechatronics Engineering

Fluid mechanics and thermal Lab

Experiment #1: “Volumetric Hydraulic Bench”

Group Members:

1.

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Due Date: / /

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| 1. Objectives
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This experiment aims to demonstrate the main parts of volumetric hydraulic bench and its operation. The volumetric bench unit in addition to the stop watch can be used to determine the volumetric flow rate by measuring volume on tank’s level indicator and flow time. The experiment was repeated to measure same flow rate at different water levels (volumes). Average value of calculated mass flow rate = 0.209 kg/s.

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| 1. Introduction
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The volumetric hydraulic bench supplies a controlled flow of water to a wide variety of laboratory experiments (several units). The bench consists of a sump tank with a submersible pump, volumetric weighing system and working surface. All parts are manufactured in corrosion-resistant material. The sump outlets allow the bench to be used on almost any hydraulic circuit. Once filled, the bench needs no external water supply. The top of the sump tank provides the working surface, on which many of the experiments range conveniently mount. A rim around the working surface contains any spilled or excess water. The bench top also incorporates an open channel for experiments investigating flow measurement with weirs. Larger experiments usually stand next to the hydraulic bench. A control valve can be used to regulate the pump and so adjust flow rate. The volumetric measuring system simply consists of a small inner tank with a level indicator. The level indicator is accurately calibrated in litres [2].

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| 1. Theoretical Background
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Volumetric flow rate = Velocity \* Hose’s cross sectional area = (Volume/time)

[Q = ν\*A = V/t]

Mass flow rate (ṁ) = ρ\* Q = ρ\*ν\*A.

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| 1. Apparatus
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1. Volumetric bench
2. Stop watch

 

Figure : Volumetric bench Unit Figure2: Stop watch

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| 1. Procedure
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1. A table was created to fill required data and results.
2. Sump was filled with water to the indicated level.
3. Coloring material was added to water to be able to see level clearly.
4. Pump was connected to 220V AC power source.
5. Output hose was leaded to the collecting tank.
6. Flow control valve was adjusted to some opening position.
7. Drain valve inside the collecting tank was closed.
8. Pump was switched on.
9. The stop watch was started to measure time once the water level indicator reaches (0 L) till (5 L), the data was recorded in the table.
10. Step (9) was repeated at different volume ranges (0- 15)L, (0-25)L, (0-35) L.

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| 1. Results
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| Volume(V) (L) | Volume(V) (m3) | Time (t)(s) | Volumetric flow rate(Q) (m3/s) | Mass flow rate (ṁ)(Kg/s) |
| 5 | **0.005** | **22** | **22.72 \* 10-5** | **0.2272**  |
| 15 | **0.015** | **78** | **19.23 \* 10-5** | **0.1923** |
| 25 | **0.025** | **120** | **20.83 \* 10-5** | **0.2083** |

* Sample calculation.

Volume (V)= 5L = 0.005 m3

The Volumetric flow rate (Q) = V (m3)/t (s) = ( 0.005/22) = 2272 \* 10-7 m3/s

The mass flow rate (
{\displaystyle {\dot {m}}}**ṁ**)=Q\*Density(ρ) = 2272 \* 10-7 \* 1000 = 2272 \* 10-4 Kg/s

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| 1. Conclusion
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Volumetric bench was used to measure volumetric flow rate of water through which mass flow rate was calculated for several water levels (volumes) at the same rate. Similar results were obtained for different volume levels, the calculated average volumetric flow rate = 20.9\*10-5 m3/s , whereas the calculated average mass flow = 0.209 kg/s.

1. **References**
2. Manual laboratory hand book.
3. TecQuipment Ltd , Bring Life Back to Old Lab Equipment with a Retrofit Upgrade - H1X” https://www.tecquipment.com/assets/img/general/Hydraulic-bench-conversion-kit.pdf”, accessed on Sep. 8th, 2020.