Experiment Details

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| --- | --- |
| Department Name | Civil and Environmental Engineering |
| Class | Second year |
| Semester | Third |
| Subject Name | Fluid Mechanics Laboratory |
| Experiment No. | 01 |
| Experiment Name | Basic definitions in Fluid Mechanics |

Version History

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| --- | --- | --- | --- | --- |
| Sr. No. | Version Number | Created By | Approved By | Date |
| 1 | v1.1 | Saie Dhavale | Sourabh Joshi | 09/10/2020 |
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AIM:

To study the basics definitions in fluid mechanics.

THEORY:

**Kinematic Viscosity:**

It is a ratio of dynamic viscosity and mass density of liquid/fluid denoted by symbol ‘v’ (nu), i.e. v = µ/l

It’s unit being ‘Sq.m/s’ or stoke (Sq.cm/s).

**Ideal Fluids:**

It is h hypothetical fluid where in it is taken that the viscosity is zero. An ideal fluid is non-viscous and incompressible.

**Real Fluid:**

All fluids that have viscosity are called real fluids.

**Pressure:**

It is the force exerted upon a unit area. It be assumed that cross sectional area ‘A’ is filled up to a height ‘h’ by a liquid having unit weight ‘γ’. The force exerted by the liquid column per unit area at its bottom is equal to.

P = γ A h/A = γ h

In fluid mechanics a pressure is generally expressed in terms of height of liquid column, i.e. h = P/ γ, were ‘h’ is known as the pressure head and has the dimension of length. Steady pressure can be measured using pressure gauges, pressure transducers, piezometers & Manometer.

**Newtonian and non-Newtonian fluid:-**

Fluids that obey the Newton’s law of viscosity, viz ح = µ du/dy are called Newtonian fluids and those which do not obeys the said law are called non-Newtonian fluids.

**Discharge:**

It is the volumetric rate of flow of fluid. It is denoted by ‘Q’ (cubic-meter/s)

**Velocity:**

By velocity unless specified other wise, men velocity of flow is implied and is obtained by dividing the rate of flow Q by the flow cross section i.e.

v = Q/A

Velocity at any point in a flow section is commonly measured by means of a Pitot-static tube or current meter.

**Absolute and Gauge Pressure:**

Gauge pressure = Absolute pressure – local atmospheric pressure

And in case of gauge pressure is negative, then

Vacuum or negative pressure = Local atmospheric pressure – Absolute pressure

The standard atmospheric pressure is taken as equal to 76 cm of mercury.

## TABLE NO. 1: Mass density, specific weight and Kinematic viscosity of some common fluids at 200C & atmospheric pressure

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Fluids** | **Mass density** | | **Specific weight** | | **Kinematic**  **Viscosity** |
| **S.I. units kg/m3** | **MKS unit msl/m3** | **S.I. unit**  **N/m3** | **MKS unit kgf/m3** | **S.I. and MKS unit m2/s** |
| Water |  |  |  |  |  |
| Air |  |  |  |  |  |
| Alcohol |  |  |  |  |  |
| Glycerin |  |  |  |  |  |
| Mercury |  |  |  |  |  |
| Carbon Tetrachloride |  |  |  |  |  |

## TABLE NO. 2: Physical quantities & their units

|  |  |  |  |
| --- | --- | --- | --- |
| **Physical quantity** | **Dimension** | **M.K.S. unit** | **S.I. unit** |
| Length | L | Meter(M) | Meter (M) |
| Mass | M | Metric Slug (msl) | kilogram (kg) |
| Time | T | Second (s) | Second (s) |
| force | MLT-2 | Kilogram (kgf) | Newton (N) |
| Energy | ML2T-2 | kilogram-meter (kgf-m) | Joule (J) |
| Power | ML2T-3 | kilogram-meter Second (kg-f-m/s) | Watt (w) |
| Dynamic | ML-1T-1 | Kilogram. Second | Newton second/m2 |
| viscosity |  | (meter)2 (kg-f-s/meter3) | (N-s/m2) |

TABLE NO. 3: Mass density of air, Kinematic viscosity of air & water at different temperatures.

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| --- | --- | --- | --- |
| **Sr. No.** | **Temperature**  **(0C)** | **Mass density of air** | **Kinematic Viscosity of air** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | **M.K. S. unit msl/m3** | **S.I. units kg/m3** | **Air (*v* x 10-6) m2/s** | **water (*v* x 10-7) m2/3** |
| 01 | 15 |  |  |  |  |
| 02 | 16 |  |  |  |  |
| 03 | 17 |  |  |  |  |
| 04 | 18 |  |  |  |  |
| 05 | 19 |  |  |  |  |
| 06 | 20 |  |  |  |  |
| 07 | 21 |  |  |  |  |
| 08 | 22 |  |  |  |  |
| 09 | 23 |  |  |  |  |
| 10 | 24 |  |  |  |  |
| 11 | 25 |  |  |  |  |
| 12 | 26 |  |  |  |  |
| 13 | 27 |  |  |  |  |
| 14 | 28 |  |  |  |  |
| 15 | 29 |  |  |  |  |
| 16 | 30 |  |  |  |  |

PRE TEST:

1. In which type of matter one won’t find a free surface:
   1. Solid
   2. Liquids
   3. Fluids
   4. **Gases**
2. Which one is in a state of failure?  
    a) Solid  
    b) Liquid  
    c) Gas  
    d) **Fluid**
3. Which of the following are considered as fluids:
   1. Liquids
   2. Liquids and gasses
   3. **Liquids, gasses and plasma**
   4. None of the above
4. A branch of Physics concerned with mechanics of fluids and forces on them is called as:
   1. Fluid statics
   2. **Fluid mechanics**
   3. Continuum mechanics
   4. Fluid dynamics
5. Fluid Mechanics can be applied in which of the following:
   1. Meteorology and Ocean engineering
   2. Civil and Environmental engineering
   3. Biomechanics
   4. **All of the above**

POST TEST:

1. Viscosity of Ideal fluid is:
   1. One
   2. **Zero**
   3. Two
   4. None of the above
2. Dimension of energy is:
   1. ML-1T-1
   2. **ML2T-2**
   3. ML2T-3
   4. ML-1T-2
3. Steady pressure can be measured using
   1. piezometers
   2. Manometer
   3. pressure gauges, pressure transducers
   4. **All of the above**
4. Velocity at any point in a flow section is commonly measured by means of:
   1. Pitot-static tube
   2. Current meter
   3. **Both of the above**
   4. None of the above
5. Dimension of power is:
   1. ML-1T-1
   2. ML2T-2
   3. **ML2T-3**
   4. ML-1T-2

REFERENCE :

KIT College of Engineering Lab manual.