EXPERIMENT NO. 6

Aim: To determine the coefficient of viscosity of a given viscous liquid by measuring the terminal velocity of a spherical body.

Apparatus: Glass tube containing the viscous liquid, spherical body, screw gauge, stop watch.

Theory: Terminal velocity is the constant velocity with which the body moves in a liquid after acceleration. The relation for coefficient of viscosity of the liquid is given by:

\[ \eta = \frac{2 r^2 (\rho - \sigma) g}{9 v_t} \]  

Where:
- \( r \) – radius of the spherical body
- \( \rho \) – density of the spherical body (Iron: 7.8 g cm\(^{-3}\), lead: 11.3 g cm\(^{-3}\), steel: 7.77 g cm\(^{-3}\))
- \( \sigma \) – density of the liquid (Castor oil: 0.96 g cm\(^{-3}\), vegetable oil: 0.91 g cm\(^{-3}\), glycerine: 1.26 g cm\(^{-3}\))
- \( v_t \) – terminal velocity of the body

Procedure:
1. Measure the radius of the sphere using a screw gauge.
2. Drop the object in the liquid and observe the time it takes to cover a definite length. Measure the time using a stop watch.
3. Calculate the coefficient of viscosity of the liquid using equation (1)

Result: The coefficient of viscosity of the given liquid is _______ poise

Precautions:
1. The body should be perfectly spherical
2. Velocity should be measured only when it becomes a constant

Sources of error:
1. The liquid may not have uniform density
2. The measured velocity may not be a constant.
Observations:

Zero error:
LC =
Zero correction:

To find the diameter

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>LSR (mm)</th>
<th>CSD (n)</th>
<th>CSR</th>
<th>d = PSR + CSR (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Observed</td>
<td>Corrected</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mean diameter(d) = mm; radius of the sphere = mm = cm

To find the terminal velocity

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Distance (cm)</th>
<th>Time (s)</th>
<th>Velocity (cm/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Calculations:

Terminal velocity, \( v_t \) = cm/s

Viscosity \( \eta \) = \( \frac{2r^2(\rho-\sigma)g}{9v_t} \)