



EXPERIMENT NO.- 4

- a) Standard Test Method for Normal Consistency of Hydraulic Cement.
- **ASTM C187**
 - b) Standard Test Method for Fineness of Hydraulic Cement by the 75- μm (No. 200) Sieve.
- **ASTM C430**
 - c) Soundness of Cement by Le-Chateliers Method.
- **IS:4031**
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4 (a) Standard Test Method for Normal Consistency of Hydraulic Cement.

- **ASTM C187**

INTRODUCTION

- The amount of water content that brings the cement paste to a standard condition of wetness is called **Normal Consistency**.
- It has marked effect upon the **time of set** as well as upon other properties.
- The paste at normal consistency is fairly stiff and is used only for the **determination of time of set and soundness**.
- The usual range of Normal Consistency lies between **22 to 30 Percent** by weight of dry cement.

APPARATUS



1. Balance: Sensitive to 0.1 mg.

The permissible variations on weights in use in weighting the cement shall be as prescribed in Table 4.1.

Table: 4.1: Permissible variations on weights

| Weight (gm) | Permissible Variations on Weights in use, plus or minus (gm) |
|-------------|--|
| 500 | 0.18 |
| 300 | 0.15 |
| 250 | 0.13 |
| 200 | 0.10 |
| 100 | 0.07 |
| 50 | 0.04 |
| 20 | 0.02 |
| 10 | 0.02 |
| 5 | 0.01 |
| 2 | 0.01 |
| 1 | 0.01 |



2. Three Glass Graduates : 200 or 250 ml capacity

3. Mixing Plate

4. Small Trowel

5. Three 4 in. Square Glass Plates

6. Vicat Apparatus

- The Vicat Apparatus shall consist of a **frame A** (see Figure) bearing a **movable rod B**, Weighing 300g, **one end C**, the plunger end, being 10 mm in diameter for a distance of at least 50 mm in length.
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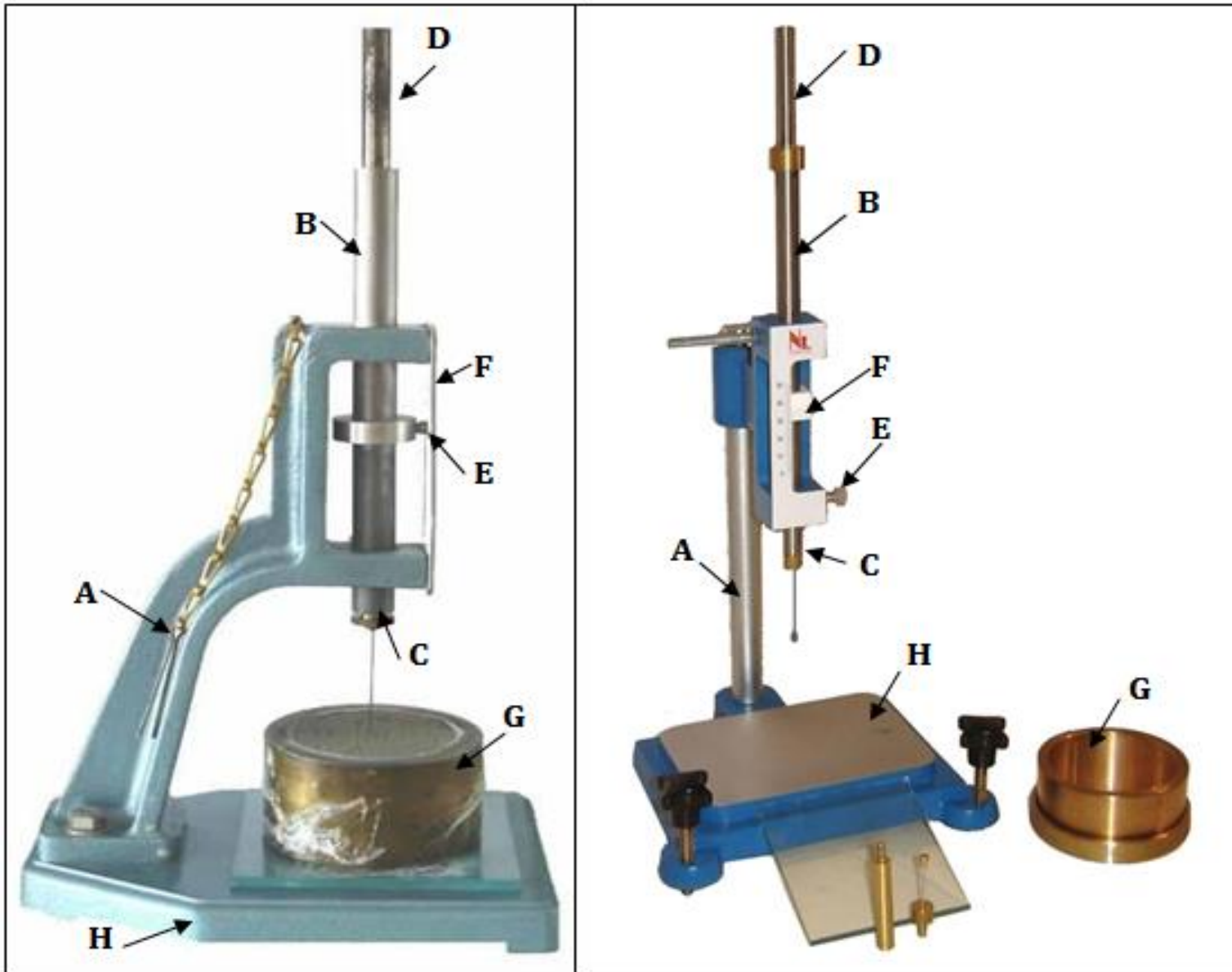


Figure: Vicat Apparatus

APPARATUS

CONT'D



- The **rod B** is reversible; and can be held in any desired position by a set **screw E**, and has an adjustable **indicator F** which moves over a scale (graduated in millimeter) attached to the **frame A**.
- The paste is held in a rigid **conical ring G**, resting on a **glass plate H** about 100 mm, square.
- The **rod B** shall be made of **stainless steel** having a hardness of not less than 35 HRC (Rockwell Hardness Number).
- The ring shall be made of a non- corroding, non-absorbent material



❑ In addition to the above, the Vicat apparatus shall conform to the following requirements:

| | |
|-----------------------------------|--|
| Weight of movable rod | 300 ± 0.5 gm |
| Diameter of plunger end of rod | 10 ± 0.05 mm |
| Diameter of needle | 1 ± 0.05 mm |
| Height of ring | 40 ± 1 mm |
| Inside diameter of ring at bottom | 70 ± 3 mm |
| Inside diameter of ring at top | 60 ± 3 mm |
| Graduated scale | The graduated scale, when compared with a standard scale accurate to within 0.1 mm at all points, shall not show a deviation at any point greater than 0.25 mm |



TEMPERATURE AND HUMIDITY

- The **temperature of the air** in vicinity of the mixing slab, the dry cement, molds, and base plates shall be maintained **$23 \pm 4^{\circ}\text{C}$** .
 - The **temperature of the mixing water** shall not vary from **23°C** by more than **$\pm 2^{\circ}\text{C}$** .
 - The **relative humidity** of the laboratory shall be **not less than 50%**.
-

PROCEDURE



Preparation of Cement paste:

- Weigh out **650 gm cement** and place on the mixing plate.
- Form crater in the center and add a measured quantity of water (**22 to 30%** by weight).
- Turn the material at the outer edge into the crater within **30 sec** with a trowel.
- After an additional **interval** of **30 sec** for the absorption of the water, complete the operation by continuous, vigorous mixing, squeezing and kneading with the hands for **1.5 min**.



Molding Test Specimen:

- Quickly form the cement paste into the approximate **shape of a ball** with gloved hands.
- Then **toss six times** through a **free path of about 150 mm** from one hand to another so as to produce a nearly **spherical mass** that may be easily inserted in to the Vicat ring with a minimum amount of additional manipulation.
- Press the ball, resting in the palm of one hand, into the larger end of the conical ring G, held in the other hand, completely filling the ring with paste.

PROCEDURE

CONT'D



- Remove the excess at the larger end by a single movement of the palm of the hand.
- Place the ring on its larger end on a plane, non absorptive plate H, and slice off the excess paste at the smaller end at the top of the ring by a single oblique stroke of a sharp-edged trowel held at a slight angle with the top of the ring and smooth the top, if necessary, with a few light touches of the pointed end of the trowel.
- During these operations of curing and smoothing take care not to compress the paste.



Consistency Determination:

- Center the paste confined in the ring, resting on the plate, under the rod **B**, the plunger end of which shall be brought in contact with surface of the paste, and tighten the set-screw **E**.
- Then set the movable indicator **F** to the upper zero mark of the scale, or take an initial reading, and release the rod immediately.
- This must not exceed 30 sec after completion of mixing.
- The apparatus shall be free of all vibrations during the test.
- The paste shall be of normal consistency when the rod settles to a point 10 ± 1 mm below the original surface in 30 sec after being released.



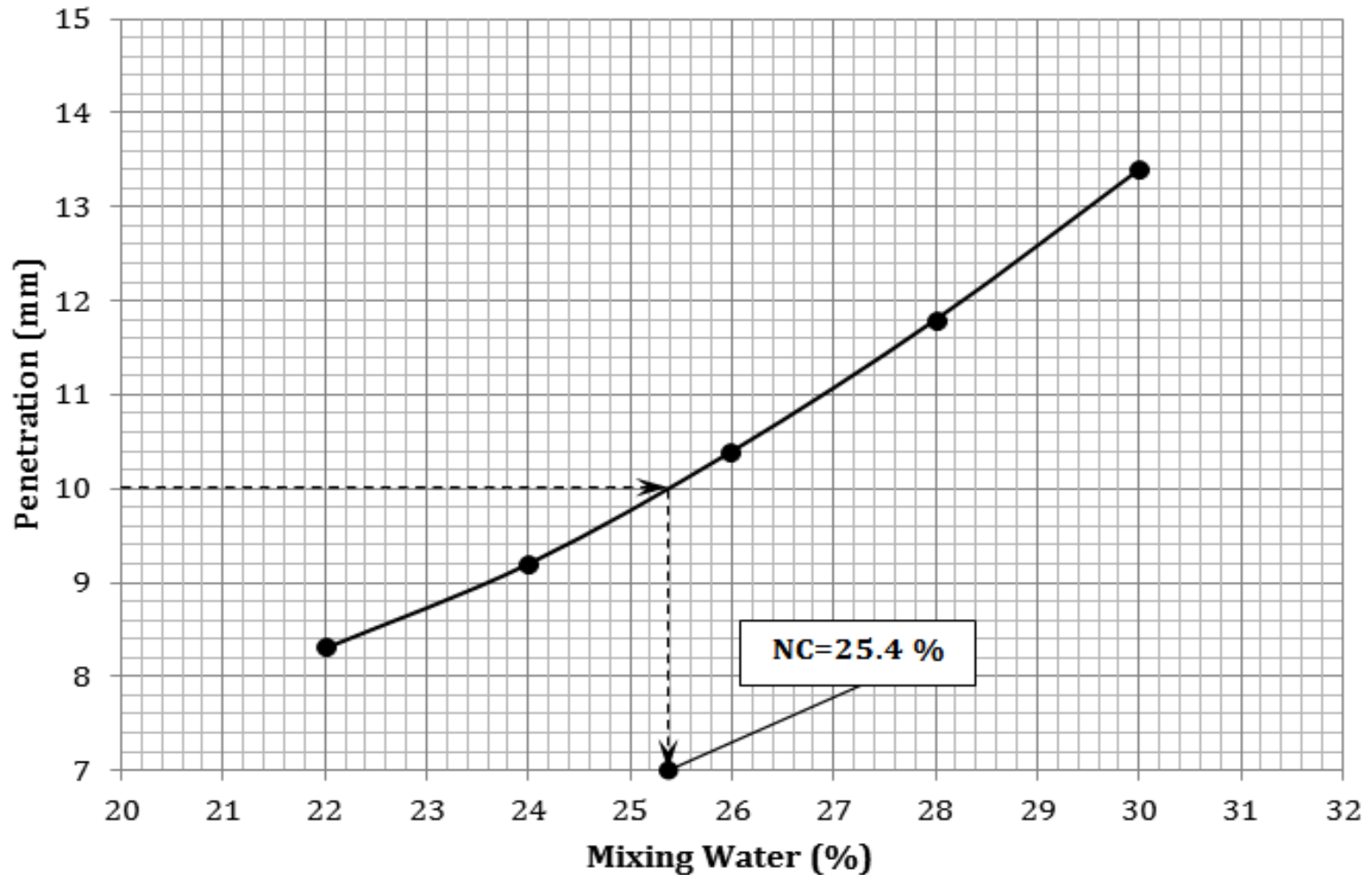
CALCULATION

- Calculate the amount of water required for normal consistency to the nearest 0.1% and report it to the nearest 0.5% of the weight of the dry cement.
 - Plot the amount of mixing water used as abscissa and observed penetration as ordinate in a plain graph paper.
 - Then using this plot determines the amount of water required for 10 mm penetration.
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SAMPLE GRAPH



Penetration vs. Water Percent Curve



SAMPLE DATA SHEET



Data Sheet

| <i>Obs. No.</i> | <i>Percentage of Water (%)</i> | <i>Penetration (mm)</i> |
|-----------------|------------------------------------|-----------------------------|
| | | |
| | | |
| | | |
| | | |
| | | |

RESULT:

Percentage of Water required for Cement Paste of Normal Consistency = %
(to the nearest 0.5 %)



REPORT

The Report shall include the following information:

- Type of Cement (e.g. OPC, CEM I)
 - Brand name of Cement
 - Report normal consistency to the nearest **0.5%** of the weight of the dry cement
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QUESTIONS?

- Does this cement satisfy ASTM standards requirements for normal consistency?
 - Describe the factors affecting the normal consistency of cement.
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4 (b) Standard Test Method for Fineness of Hydraulic Cement by the 75- μm (No. 200) Sieve. - **ASTM C430**

INTRODUCTION

- This test method covers the determination of the fineness of hydraulic cement by means of the 75- μm (No. 200) sieve.
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APPARATUS

Balance: Sensitive to 0.01 g

Sieve: 75- μm (No. 200) sieve

PROCEDURE



- Accurately weight **200 gm** dry cement sample
- Sieve the sample using a **#200 sieve**
- Weight the sample **retain** on the sieve
- Calculate the **Blaine fineness** indirectly from the % of cement retain on the # 200 sieve

| % Sample passing on #200 sieve | Blaine Fineness (cm²/gm) |
|---|--|
| > = 97 | 4000 |
| 95 – 96.9 | 3800 |
| 92 – 94.9 | 3600 |
| 87 – 91.9 | 3300 |
| 82 – 86.9 | 3000 |
| 76 – 81.9 | 2500 |



SAMPLE DATA SHEET

| Obs. No. | Material retain on #200 sieve (gm) | Percentage of material retained |
|----------|--|---------------------------------------|
| 1 | | |
| 2 | | |
| 3 | | |

RESULT:

Blaine Fineness of the Cement Sample = (cm²/gm)



REPORT

The Report shall include the following information:

- Type of Cement (e.g. OPC, CEM I)
 - Brand name of Cement
 - Report Blaine Fineness in cm^2/gm
-

4 (c) Soundness of Cement by Le-Chateliers Method. - IS:4031



INTRODUCTION

- In the soundness test a specimen of hardened cement paste is boiled for a fixed time so that any tendency to expand is speeded up and can be detected. Soundness means the **ability to resist volume expansion**.
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APPARATUS

| NAME | CAPACITY / RANGE / SIZE | ACCURACY / LEAST COUNT |
|---------------------------|----------------------------------|---------------------------|
| Le-chatelier apparatus | Should be made as per IS:5514 | |
| Water bath | 100°C (min) | 1°C |
| Caliper | 30 cm | 0.5 mm |
| Measuring cylinder | 100 ml | 1 ml |
| Balance | 100 g | 1 g |

APPARATUS

- Glass sheets (2 nos)
- Enamel tray
- trowel



Figure: Le-Chateliers Apparatus



ENVIRONMENTAL CONDITION

| | |
|-------------|-----------------------------|
| Temperature | $27 \pm 2^{\circ} \text{C}$ |
| Humidity | $65 \pm 5 \%$ |

PROCEDURE



- Before commencing soundness test, do the consistency test to obtain the water required to give the paste normal consistency (P).
- Prepare a paste by adding 0.78 times the water required to give a paste of standard consistency (i.e. $0.78P$).
- Lightly oil the Le-chatelier mould and place it on a lightly oiled glass sheet.
- Fill the mould with the prepared cement paste. In the process of filling the mould keep the edge of the mould gently together.
- Cover the mould with another piece of lightly oiled glass sheet, place a small weight on this covering glass sheet.

PROCEDURE

CONT'D



- Submerge the whole assembly in water at a temperature of $27 \pm 2^{\circ}\text{C}$ and keep there for 24 hours.
 - Remove the whole assembly from water bath and measure the distance separating the indicator points to the nearest 0.5 mm (L1).
 - Again submerge the whole assembly in water bath and bring the temperature of water bath to boiling temperature in 25 to 30 minutes. Keep it at boiling temperature for a period of 3 hours.
 - After completion of 3 hours, allow the temperature of the water bath to cool down to room temperature and remove the whole assembly from the water bath.
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- Measure the distance between the two indicator points to the nearest 0.5 mm (L2)

SAMPLE DATA SHEET



Measurement taken after 24 hours of immersion in water at a temp. of $27 \pm 20^{\circ}\text{C}$, $L1 =$ mm

Measurement taken after 3 hours of immersion in water at boiling temperature, $L2 =$ mm

RESULT:

Soundness/expansion of cement $(L1-L2) =$ mm



CALCULATION

Soundness/expansion of cement = L1-L2 mm



REPORT

The Report shall include the following information:

- Type of Cement (e.g. OPC, CEM I)
 - Brand name of Cement
 - Soundness/expansion of cement to the nearest **0.5 mm**
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