

INTRODUCTION :

CONCRETE-

Concrete is a construction material which is used all over the world.

It is formed by mixing cement, sand and aggregates and also the admixtures to enhance its properties.

CONSTITUENTS OF CONCRETE :

- Cement
- Sand
- Aggregates
- Admixtures

CEMENT :

Cement is widely used construction material. It is used as a binding material.



COMPOSITION OF CEMENT :

Oxide	Percent , content
CaO	60-70
SiO ₂	17-25
Al ₂ O ₃	3.0-8.0
Fe ₂ O ₃	0.5-6.0
MgO	0.1-4.0
Alkalies (K ₂ O, Na ₂ O)	0.4-1.3
SO ₃	1.0-3.0

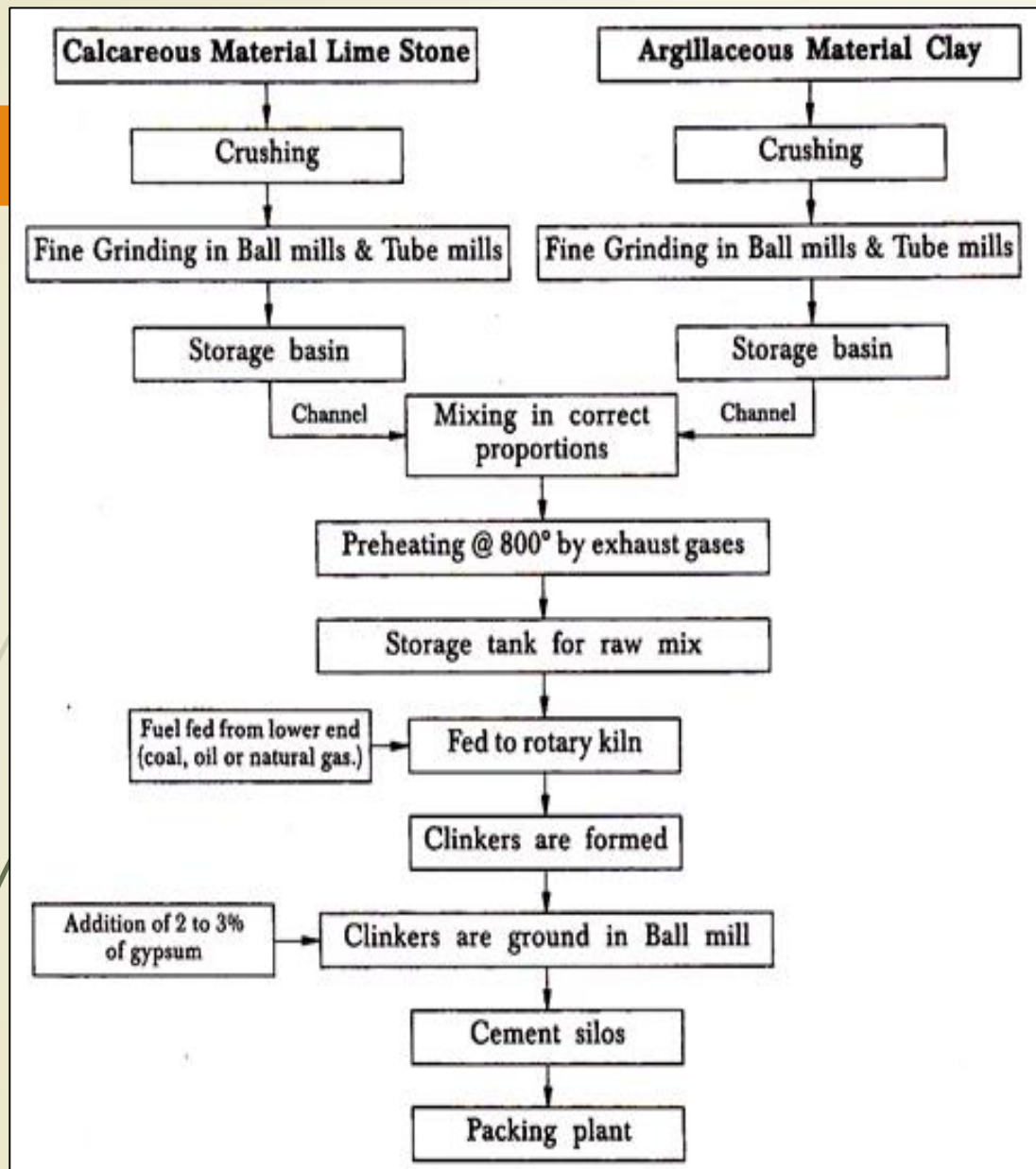
MANUFACTURE OF CEMENT :

Two types of process of manufacture-

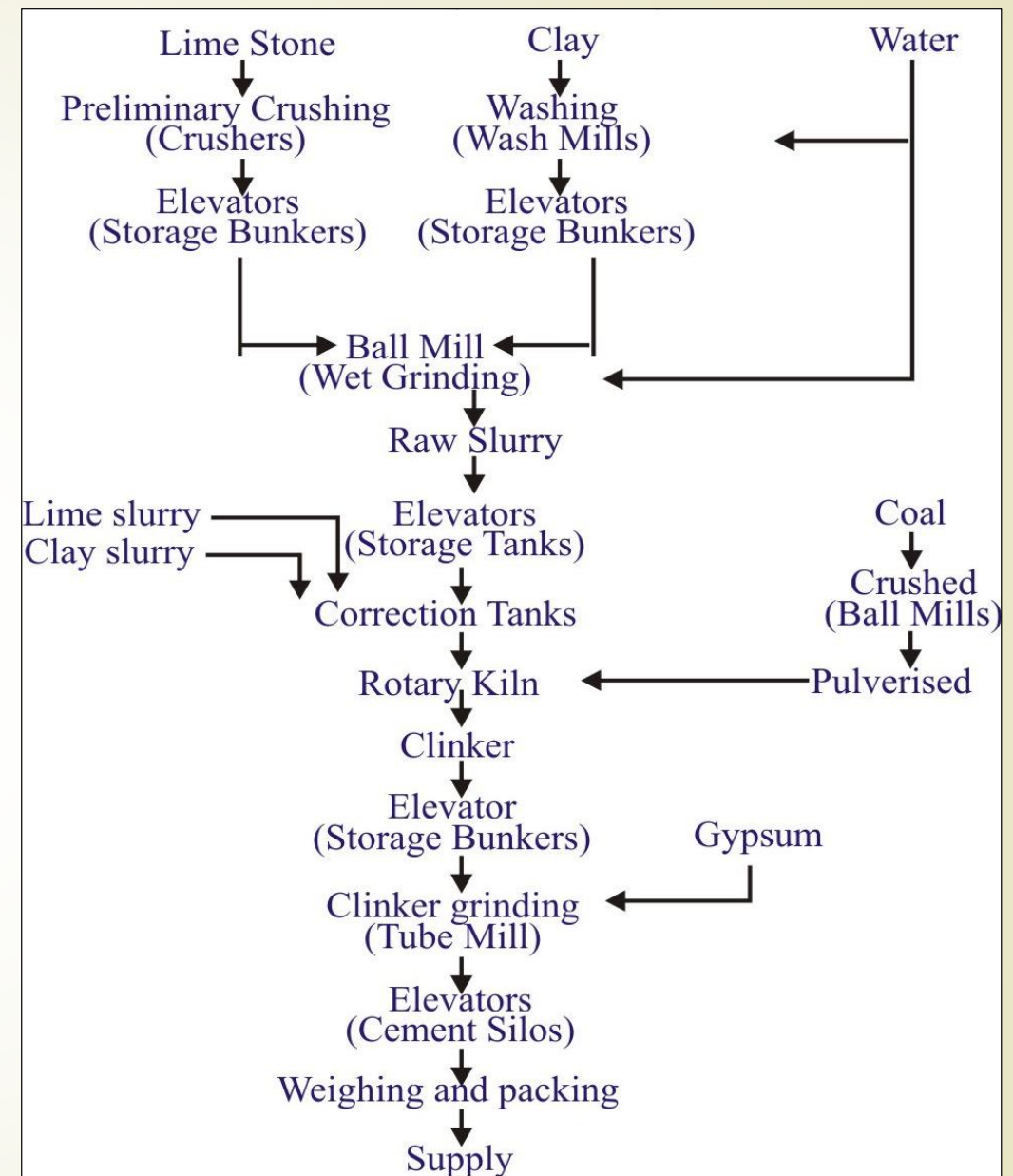
1. Dry Mix Process
2. Wet Mix Process

TESTS OF CEMENT :

1. Field tests
2. Laboratory Tests




Dry Mix Process



Wet Mix Process

TYPES OF CEMENT :

- 1. Ordinary Portland Cement (OPC)-** Portland cement is the most common type of cement in general use around the world as a basic ingredient of concrete. The principal raw materials used in the manufacture of Ordinary Portland Cement are: Argillaceous or silicates of alumina in the form of clays and shales. Calcareous or calcium carbonate, in the form of limestone, chalk and marl which is a mixture of clay and calcium carbonate.
- 2. Rapid Hardening Cement-** It develops higher rate of development of strength. The rapid rate of strength development is due to the higher fineness of grinding and higher C3S and lower C2S content.
- 3. Sulphate Resisting Cement-** OPC is susceptible to sulphate attack. The use of cement with low C3A content is found to be effective. Such cement with low C3A and comparatively low C4AF content.




4. Blast-furnace Slag Cement- It is obtained by mixing OPC clinker, gypsum and granulated blast furnace slag. The quantity of granulated slag mixed with OPC clinker range from 25-65%. The heat of hydration of Portland blast furnace slag cement is lower than that of OPC.

5. Quick Setting Cement- This cement sets very quickly. It is obtained by reducing the gypsum content at the time of clinker grinding. It is mostly used in under water construction.

6. Low Heat Cement- This cement has Low heat development. A low heat is achieved by reducing the contents of C3S and C3A and increasing C2S content.

7. Pozzolana Cement- A pozzolana is a siliceous material. The pozzolana used in the manufacture of Portland Pozzolana cement may include such natural materials like opaline cherts and shales, volcanic ashes and pumicites. Materials processed by calcination of soil and fly ash etc. are also used.



8. Air-entraining Cement- The Synthetic detergents of the alkyl-aryl sulphonate types, Calcium ligno-sulphate, Alkali salts of wood resins are used to manufacture this cement. These agents in the form of powder or in liquids are added to the extent of 0.025-0.1% by weight of the cement clinker. It helps to improve workability of the concrete.

9. Coloured Cement- White cement or OPC is used as a base. Portland cement consists with 5-10% of coloured pigment to used in its manufacture.

10. Hydrophobic Cement- It is obtained by grinding OPC clinker with water repelling film forming substance such as oleic acid and stearic acid.

11. High Alumina Cement- It is obtained by fusing mixture, in suitable proportions of alumina and calcareous materials and grinding them into a fine powder.

12. Expansive Cement- It is obtained by using an expanding agent and a stabilizer very carefully. About 8-20 parts of the sulpho-aluminate clinker mixed with 100 parts of the OPC and 15 parts of the stabilizer.

13. Oil-well Cement- It is obtained by adjusting the compound composition of cement or by adding retarders to the OPC. The retarding agents are starches or cellulose products or acids.

FIELD TESTS FOR CEMENT :

- Colour of Cement Should be Greenish Grey.
- Should not contain any visible lumps.
- Should have homogeneous colour and texture.
- Should give Cool feeling when hand is thrust inside the bag of cement.
- Should give smooth feeling not gritty when rubbed between the fingers.
- When a handful of cement is thrown in a bucket full of water it should float on the surface of water before sinking.

LABORATORY TESTS FOR CEMENT :

1. Fineness test of cement
2. Standard Consistency test of cement
3. Initial Setting and Final Setting test of cement
4. Soundness test
5. Compressive Strength test of cement

1. FINENESS TEST OF CEMENT :

- This test of cement is performed to check the fineness of cement according to standard specifications.
- The fineness of cement can be measured either by the grain size of cement or by the surface area of cement.
- The sieve Test (IS 4031- part-I) – 90 μ size sieve.
- The fineness of cement has a significant effect on the hydration and in increasing the rate of gain strength. The strength of cement is directly proportional to its fineness.

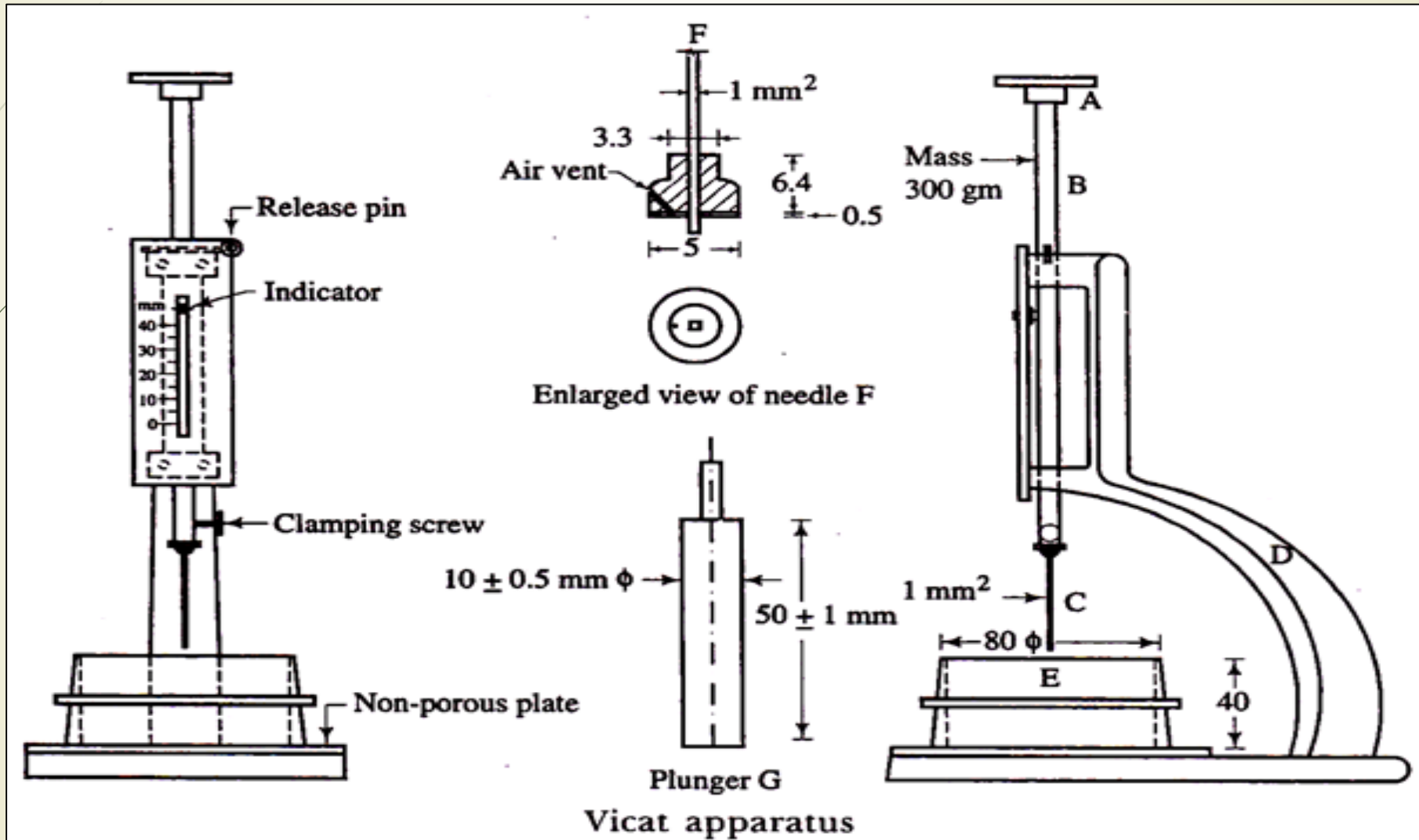


2. STANDARD CONSISTENCY TEST OF CEMENT :

- It is used to find out the percentage of water required to produce cement paste of standard consistency.
- It is also sometimes called as Normal Consistency (CPNC).
- The Standard consistency of a cement paste is defined as that consistency which will permit a Vicat's apparatus plunger having 10mm dia. and 50mm length to penetrate to a depth of 33-35 mm from the top of the mould.



3. INITIAL SETTING AND FINAL SETTING TESTS OF CEMENT :



Initial Setting time-

- When the paste will start losing its plasticity, the needle will penetrate only to some depth.
- The period elapsing between the time when water is added to the cement and to the time at which the needle penetrates the test block to a depth equal to 33-35mm from the top is taken as initial time.
- For OPC it is generally taken as 30min.

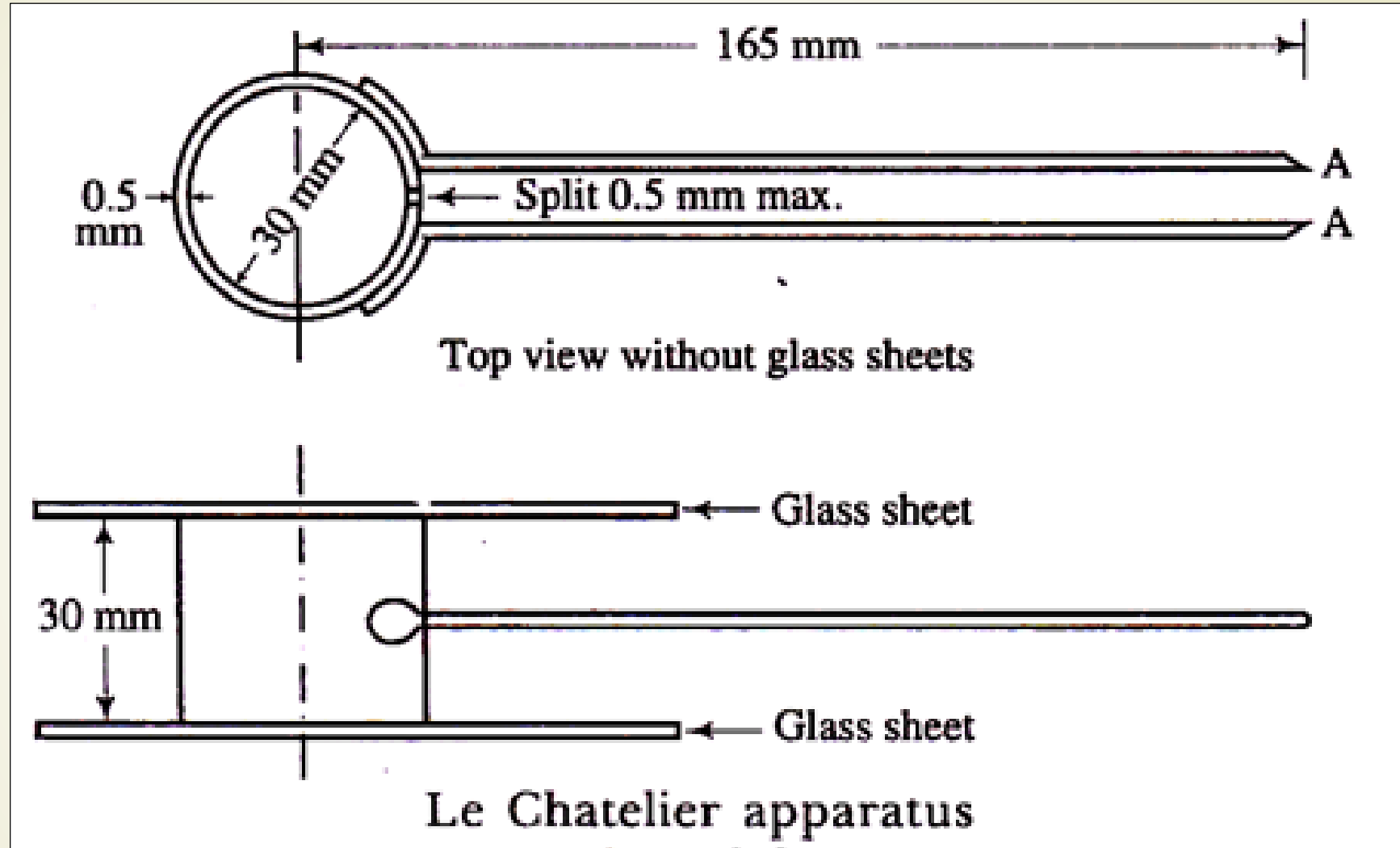
Final Setting time-

- The cement is considered fully set when the centre needle makes an impression while the annular attachment fails to do so.
- The cement is said to be hard if it does not pierce more than 0.5mm.
- It is generally taken as 10 hrs.

4. SOUNDNESS TEST :

- The Cement is said to be unsound if it has excess of lime.
- Due to high proportions of magnesium content or Calcium sulphate content.
- Because of inadequate burning of cement.
- Due to insufficiency in fineness of grinding or thorough mixing of raw materials.
- It cause appreciable change in the volume of cement after the cement has set causing disruption of the set and hardened mass.
- Le-Chatlier's Apparatus is used for the test.
- In case the expansion is more than 10mm than the cement is said to be unsound.





Le Chatelier's apparatus

5. COMPRESSIVE STRENGTH TEST OF CEMENT :

- It is Laboratory method to determine the strength of cement.
- The size of cube mould is 70.6mm.
- Cement and standard sand mortar is used to make the cube.
- Three cubes are tested for the strength.
- The average value is taken for the compressive strength of the three cubes for each period respectively.

