CIVIL ENGINEERING DEPARTMENT

LABORATORY INSTRUCTION MANUAL FOR

CE216: Building Materials & Concrete Technology

PROCEDURES

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EXPERIMENT A.1:

FINENESS OF CEMENT BY SIEVE ANALYSIS METHOD

THEORY & IMPORTANCE:

This experiment is carried out to check the proper grinding of cement. The cement which is produced by an industry is checked for its quality, that either it is good for certain type of construction or it doesn't possess that much strength. For example, for RCC and other heavy load bearing structures such as bridges it is essential that the cement which is being used in the concrete should have the ability to provide the required strength, while in the PCC structures it is not so much critical.

The ability to provide strength of a certain type of cement is checked by finding the fineness of that cement, because the fineness of cement is responsible for the rate of hydration and hence the rate of gain of strength and also the rate of evolution of heat. When cement is mixed with the water, a thin layer is formed around the particle. This layer grows bigger and makes cement particles to separate. Due to this, hydration process slows down. Therefore, the smaller particle will react much quicker than the larger particle. A particle with diameter 1μm will react entirely in one day, whereas the particle with diameter 10μm takes about one month. So, the particle size distribution is more critical in attaining the final strength of cement in allowable time. But too much of smaller particles in cement results in quick setting, leaving no time for mixing, handling and placing. So, to increase the setting time of cement, cement is ground in a different range of particle sizes.

The following proportions are usually maintained in Cement: About 10% of the cement of fine particles is smaller than 2 μm, 10% cement is made of particles larger than 50 μm, and only few particles are larger than 90 μm.

If the cement is fine then greater is its cohesiveness, which is the property, required in the concrete because it gives compactness to the concrete.

The below table gives details about the percentage of strength loss for different time intervals.

Age of cement	Percentage of Cement Strength reduction
3 months	20%-30%
6 months	30%-40%
12 months	40%-50%

TYPES OF SIEVES:

There are different types of sieves such as #10, #30, #50, #100 etc. The number of the sieve indicates the number of holed present in a linear inch of that sieve. For finding the fineness of Wet or Dry cement, following number sieve is recommended by ASTM.

Cement by wet process = # 300 sieve

Cement by dry process = # 200 sieve (75 µm)

STANDARD:

ASTM C786-10

IS: 4031 (Part 1) – 1996 (90 µm)

APPARATUS:

- Sieve # 200
- Sample of cement
- Triple beam balance
- Brittle brush
- Empty plate

PROCEDURE:

1. Take the triple beam balance and adjust the reading of the balance to zero.

2. Take a pan and note its weight.

3. Put some cement in the pan placed on the balance, so that the weight of cement becomes 100 grams. This will be weight **W1** of the cement.

4. Put the cement in the sieve carefully and close the sieve tightly.

5. Start shaking the sieve horizontally; keep on shaking the sieve for 10 to 15 minutes regularly.

6. After 15 minutes take the residue left in the sieve, put it in a pre-weighed plate and note the weight **W2** of the residue with the help of triple beam balance.

7. Then by using the following formula calculate the percentage fineness of cement:
   W1= Total weight of cement
   W2= Weight of residue
   Percentage of fineness= $\left(\frac{w1-w2}{w1}\right) x100$

ASTM-STANDARD:

For 100 g sample: IF

Weight of w2< 10 g: Cement is fresh.

Weight of w2 > 10g: Cement is not fresh.

OR

% age of fineness is greater than or equal to 90 %: Cement is fresh.

% age of fineness is less than 90 %: Cement is not fresh.

READINGS:

Total weight of cement w1 = gram

Total weight of residue w2 = gram

% age of fineness = %

CALCULATION:

Note:

There are three methods of testing of fineness of cement:

1) Sieve methods. (ASTM C786-10)

2) Air permeability methods – Nurse and Blaine's method. (ASTM C204 - 18e1)

3) Sedimentation method – Wagner turbidimeter method (ASTM C115/C115M-10e1)

Sieve method measure grain size but permeability and sedimentation method measure surface area.

Since cement grain are finer than 75µm or 90µm, the sieve analysis method does not represent true means size of cement particles size

Other importance of fineness of cement:

- It can decrease bleeding, increase in fineness of cement increase the cohesiveness of concrete mix and thus reduce bleeding while compacting with vibrator.
- Fineness can also affect workability.
- Fineness test indirectly measures the surface area of particle of cement per unit mass.
- Fineness increases the strength development in the cement principally during its first 7 days.
- Finer of cement leads to a stronger reaction with alkalies and increase the chance of shrinkage and cracking of cement paste.

How to check the quality of cement on site:

1. Date of Packing (MFG Date):

Several studies stated that as the Strength of cement reduces as time goes on. As per IS Specifications cement should be retested if it is stored more than three months in the mill.

2. Color of Cement:

The color of cement should be uniform. An ideal color of cement is grey with a light greenish shade. Cement color gives an indication of excess clay or lime.

3. Check for lumps:

Lumps are formed due to the presence of moisture in cement. Cement undergoes a chemical reaction when it is reacted with the atmospheric moisture this process is termed as hydration. Moisture is a big enemy for cement. Cement becomes useless once it is hydrated with water

4. Rubbing Test:

Take a pinch of cement rub within your fingers, it should feel smooth while rubbing. If it is rough, it indicates that cement is mixed with sand.

5. Float test of cement:

Take a handful of cement and throw it in water, a good quality of Cement should sink and should not float on water.

6. Hand insertion:

Insert your hand into the cement bag. It must give you a cool feeling. It implies that the no hydration reaction taken place in cement bag,

7. Shape test of cement:

Cement is also named as Hydraulic Cement as it also sets under water.

Take a 100g of cement and make a stiff paste by adding some water. Then prepare a cement cake with sharp edges and place it on a glass plate. Immerse this plate in the water bucket. Observe that the shape shouldn't get disturbed while settling. A good cement should be able to set and attain strength in water.

8. Strength test:

Make A block of cement 25 mm x 25 mm and 200 mm long. Immerse the block in water for 7 days. Place the immersed block on supports 15000 mm apart and then load with a weight of 340 N. the block which is made of good cement should not show any sign of failure.