Construction Materials For Food Science and Engineering

Construction Material: Mortar, Plaster, Contrete

Prof. Dr. S M Iqbal Hossain
Dept. of Food Science and Engineering

Mortar and Plaster

Mortar: Mortar is a paste generally made by mixing cementing or binding material (lime or cement) and an inert material (sand or surki) with water. There are different types of mortar:

1. Lime mortar: Lime + sand + water;
2. Surki mortar: Line + surki + water;
3. Lime surki mortar: Lime + sand + Surki + water;
4. Cement mortar: Cement + sand + water
5. Mud mortar: Mud + saw dust/ rice husk/ cow dung + water

Use of mortar: Mortar is used-

1. To bind together the bricks or stones in brick or stone masonry.
2. To give a soft even bed between different layers of brick or stone masonry for equal distribution of pressure over the bed.
3. To fill up the spaces between bricks or stones for making walls tight.
4. In plastering works to hide the joints and to improve appearance, and
5. for moulding and ornamental purposes.

Mortar and Plaster

Preparation of Cement Mortar: Cement and sand measured in volume are mixed together in a particular ratio and then calculated amount of water is added to make mortar paste (1 bag of cement = 1.25 cft = 112 ibs).

How to make cement sand mortar:

- sand is first spread to uniform thickness on a non-porous platform,
- then cement is spread over sand,
- The cement and sand are mixed together thoroughly till the colour is uniform to get a dry mix,
- Then the quantity of water to be added is calculated and only half of that quantity is sprinkled on the dry mix,
- Then at the time of work the remaining quantity of water is added and the whole mixture is turned over twice or thrice to form cement mortar.
- Mortar should be used before initial setting of the cement commences.

Mortar and Plaster

Plaster: Plaster is a thin coat of mortar of different composition which is applied on both external and internal faces of walls, ceilings, columns, staircases etc. The process of applying plaster is termed as plastering.

Use of plaster: Plaster is used

1. to give a smooth and finished surface to the works,
2. to cover joints and defective workmanship,
3. to preserved surface from the action of weathering,
4. to provide a ground for decoration, white or colour washing, ornamental or architectural works.

Characteristics of good plaster:

1. It should adhere firmly to the surface on which it is applied.
2. It should not shrink or contract in volume on drying and setting.

Mortar and Plaster

Classification of plaster:

1. Lime plaster: Lime + sand + water
2. Surki plaster: Lime + surki + water
3. Lime-surki plaster: Lime + surki + sand + water
4. Lime putty: Quick lime is slaked and screened by fine screen and then immersed in water for 7 days. The paste obtained after removing excess water is termed as lime putty which is used finishing coat of plastering.
5. Mud plaster: Lime + mud/cow dung/saw dust + water
6. Cement plaster: Portland cement + standard sand (1:2 or 1:3)
7. Mosaic plaster: Marble chips or stone chips of ½ inch down size + white /colored cement in the ration of 2:1 + water.

Concrete

Concrete: Concrete is an artificial stone manufacture from a mixture of binding material and inert material with water.

composition of Concrete = Binding materials + Inert material + Water

1. **Binding materials:** cement and lime;
2. **Inert materials**: Inert materials are also called aggregate. Examples are: khoa, stone, sand or surki;

Aggregate: The inert materials used in concrete are termed as aggregates.

The aggregates are of two types:

1. **Fine Aggregate:** Sand and Surki are commonly used as fine aggregate in Bangladesh. The fine aggregate should not be larger than 3/16 inch (4.76 mm) in diameter.
2. **Coarse Aggregate:** Brick khoa, broken stones, gravels, pebbles, clinkers etc of the size of 3/16 to 2 inch are commonly used as coarse aggregate in Bangladesh. Therefore, 3/16 inch is the dividing size between fine and coarse aggregates. The coarse aggregate should be clean, strong, durable and well grades and should be free from impurities and deleterious materials such as salts, coal residues, etc.

Classification and Advantages of Concrete

Classification Concrete

There are mainly two types of concrete:

1. Lime Concrete = Lime + Surki + khoa + water
2. Cement Concrete = Cement + Sand + Khoa (or Stone) +Water

Main advantages of concrete over other construction materials are:

1. Concrete is free from defects and flows;
2. It can be manufactured to desired strength and durability with economy;
3. It can be cast to any desired shape;
4. Maintenance cost of concrete structures is almost negligible;
5. Concrete does not deteriorate appreciably with age;

Strength of Concrete

Factors Affecting the strength of concrete:

1. Type and quality of cement;
2. Grading of the aggregate;
3. Moisture content of the aggregate;
4. Water/cement ratio;
5. Proportioning of the various ingredients of concrete;
6. Method of mixing;
7. Placing and compaction (degree) of concrete;
8. Curing of concrete/ age of concrete;

Strength of Concrete

Water/cement ratio: Experiment shows that at a particular water-cement ratio the concrete gives the maximum strength, below which the water will not be sufficient to hydrate the cement.

The use of less water than required, will not give workability and will produce porous and weak concrete.

On the other hand, if more water is used than actually required, the concrete will be weak.

It is found that optimum strength of concrete can be obtained at a water-cement ration of 0.4 as unity.

If 30 lbs of water is added with 100 lbs of cement, then water cement ratio = 30/100 = 0.3

Effect of Age on Strength of Concrete

Concrete attains strength with time:

- The rate of gain of strength of different type of cement concrete are different (as shown in Figure10.1.).
- **Ordinary cement concrete** (with ordinary portland cement) gains above 70 to 75% of its final strength within 28 days and about 90 to 95% in course of 1 year
- Test have shown that for concrete made with ordinary portland cement the ratio of the 28 days to 7 days strength lie generally between 1.3 to 1.7 but the majority of the results fall above 1.5. Hence, the 28 day strength may be assumed to be 1.5 times the 7 days strength.

Strength of Concrete

Effect of Age on Strength of Concrete

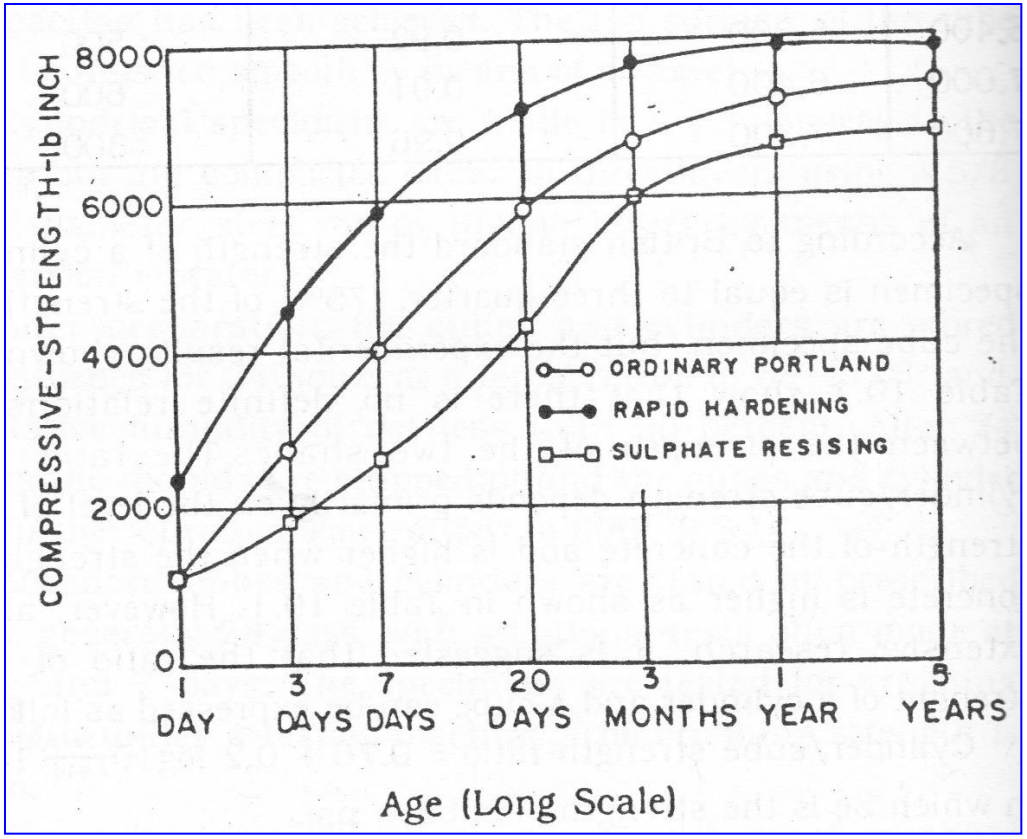

Fig. 10.1 Rate of development of strength of different type of cement concrete

Reinforced Cement Concrete

Reinforced Cement Concrete (RCC)

Concrete is very strong in compression, but comparatively very weak in tension. On the other hand, steel is very strong in tension. Therefore, steel rods of recommended size are embedded in concrete to take care of tension. Moreover, the bond between concrete and steel is very strong.

Therefore the cement concrete which is strengthened or reinforced by using steel rods is termed as Reinforced Cement Concrete (RCC).

Design of Concrete Mix

Design of Concrete Mix: Design of concrete mix can be defined as the process of selecting suitable ingredients and determining their relative quantities with the objective of producing concrete as economically as possible and with certain minimum properties such as consistency, strength and durability.

There are mainly 4 methods of designing of concrete mix:

1. Fineness Modulus Method: (Determine from the size & fineness of modulus of course and fine aggregates, their moisture content and shrinkage factor, and slump)
2. Minimum Voids Method: (Calculate the voids of course and fine aggregate, make ration on volume)
3. Trial Mixes Method: (mix with different ratio and weigh, take the heaviest one, and highest compression strength at 28 day)
4. Arbitrary Method: (1:x:2x)

Thanks