LIME CEMENT AGGREGATES MORTAR STEEL

Lime - Preparation of lime mortar - Cement - Ingredients - Manufacturing process - Types and Grades Properties of cement and Cement mortar - Hydration - Compressive strength - Tensile strength - Fineness Soundness and consistency - Setting time - Aggregates - Natural stone aggregates - Crushing strength - Impact strength - Flakiness Index - Elongation Index - Abrasion Resistance - Mortar - classifications - properties of good mortar - uses of mortar - Manufacture of steel - properties and uses of different types of steel - mechanical and heat treatment of steel - Anticorrosive measures for steel

LIME

Limestone (calcium carbonate) Burnt in a kiln loses carbon dioxide and becomes quicklime (calcium oxide) Contact with water producing great heat, to form slaked lime (calcium hydroxide), also called lime putty. This gradually takes up carbon dioxide again from the air and changes back to calcium carbonate. This 'setting' is called carbonation. Lime putty mixed with sand makes mortar. This then hardens into an artificial stone made up of grains of sand embedded in a mass of calcium carbonate.

TYPES OF LIME

Lime used shall conform to IS: 712-1984 Building limes are classified as follows:

Class A: Eminently hydraulic lime used for structural purposes.

Class B: Semi hydraulic lime used for masonry mortars.

Class C: Fat Lime used for finishing coat in plastering, white washing etc. and addition of Pozzolanic material for Masonry Mortar.

Class D: Magnesium lime used for finishing coat in plastering, white washing etc.

Class E: Kankar lime used for masonry mortars.

Class F: Siliceous dolomite lime is used generally for under coat and finishing coat of plaster.

Quick Lime: Quick Lime shall be supplied in the form of lumps and not in powder. Soon after delivery, lump lime shall be separated from powder and all under burnt/ over burnt lumps and the powder removed. Quick lime shall not be used directly in the work and shall invariably be slaked and converted to lime putty before use.

Hydrated Lime: Hydrated lime shall be in the form of a fine dry powder. It shall be supplied in suitable containers such as jute bags lined with waterproof.1ngmembrane. The bags shall bear marking indicating the class of lime, net weight, date of manufacture and the brand name. It shall be used within 4 months of its date of manufacture.

PREPARATION OF LIME

Lime Mortar

Lime mortar shall be prepared using lime putty obtained by slaking quick-lime or dry hydrated lime powder and sand with or without the addition of pozzolana ill the specified proportions.

Slaking of Lime

If lime is supplied in the form of quick lime, it shall be slaked and run into putty, if necessary, in accordance with IS: 1635-1975.

Mixing of Lime Mortars

- Putty and sand in the specified proportions shall be mixed with or without addition of water on a dry waterproof platform or in a mixer.
- The mix shall then be fed into a mortar mill with the required addition of water.
- The mortar shall be raked continuously during grinding, particularly in the angular edges of the mortar mill.
- Water may be added during grinding as required, but care shall be taken not to add more water than to bring the material to the working consistency.
- The mixing shall be done till every particle of the aggregate is coated uniformly with the cementations material.

Dry hydrated lime and sand in specified proportions shall be mixed dry first and shall then be fed into a mortar mill with required additions of water.

Generally, only as much quantity of lime mortar (except made with Class A lime) as would be sufficient for day's work shall be mixed at a time. If eminently hydraulic lime (Class A) is present as an ingredient, the 'mortar shall be used within 4 hours after grinding.

CEMENT

- Most important material in building construction
- Term "cement" means Portland Cement
- "cement" refers to the natural manufactured form limestone and clay and made available in powder form, which when mixed with water can set to a hard durable mass over under water

Ingredients (Main Constituents in cement that gives cementing properties)

(a) Dicalcium silicate 2CaO SiO_2 (denoted as C2S)

(b) Tricalcium silicate 3CaO SiO_2 (denoted as C3S)

(c) Tricalcium Aluminate 3CaOAl_2O_3 (denoted as C3A)

(d) Tetracalcium aluminium Ferrite 4CaOAl_2 O3Fe_2O_3 (denoted as C4AF)

Cement Ingredients

Lime (CaO)

Silica (SiO_2)

Alumina (Al_2O_3)

Calcium sulphate ($CaSO_4$)

Iron oxide (Fe_2O_3)

Magnesia (MgO)

Sulphur (S)

Alkalies

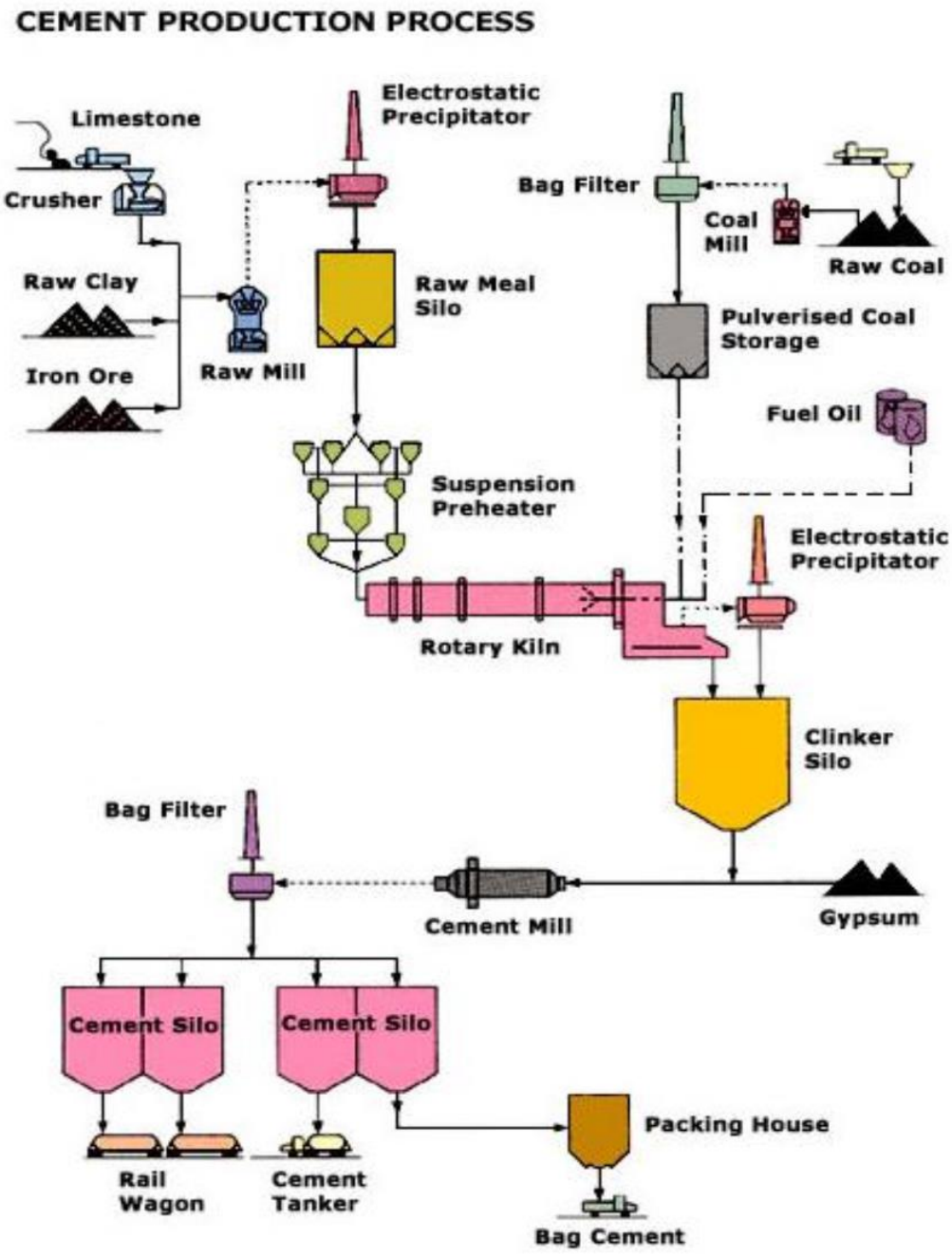
Composition of Ordinary Portland Cement

Ingredient	Percent	Range
Lime (CaO)	62	62-67
Silica (SiO_2)	22	17-25
Alumina (Al_2O_3)	5	3-8
Calcium sulphate ($CaSO_4$)	4	3-4
Iron oxide (Fe_2O_3)	3	3-4
Magnesia (MgO)	2	1-3
Sulphur (S)	1	1-3
Alkalies	1	0.2-1

MANUFACTURE OF ORDINARY CEMENT

It involves the following steps

- ✓ Mixing of raw material
- ✓ Burning
- ✓ Grinding
- ✓ Storage and packaging



MIXING OF RAW MATERIAL

- Dry process
- Wet process

DRY PROCESS

1. The raw materials are reduced in size of about 25mm in crushers.
2. A current of dry air is then passed over these dried materials
3. These dried materials are then pulverized into fine power in ball mills and tube mills.
4. All these operations are done separately for each raw material and they are stored in hoppers.
5. They are then mixed in correct proportions and made ready for the feed of rotary kiln.
6. This finely ground powder of raw materials is known as the raw mix and it is stored in storage tank

Widely used at present because of the following reasons:

Competition

Power

Quality of cement

Technology

PROCEDURE OF MANUFACTURE OF CEMENT BY THE DRY PROCESS

(a) The boulders upto 1.2 m size are transported in huge dumpers upto 300KN capacity and dumped into the hopper of the crusher

(b) The crushed limestone now of 75mm size is moved from the crushed by a series of conveyors for stacking.

(c) The argillaceous or clay materials found in the quarry are also dumped into the crusher and stacked along with the limestone.

(d) The crushed materials are checked for calcium carbonate, lime alumina, ferrous oxide and silica contents.

(e) The additive material and crushed limestone are conveyed to the storage hoppers.

(f) The materials are ground to the desired fineness in the raw mill.

(g) The material is dropped merely by gravity from the blending to the storage silo thereby conserving power.

(h) The material from the bottom of the preheater is fed to the rotary kiln.

FLOW DIAGRAM OF DRY PROCESS

Calcareous Materials Lime Stone / Argillaceous Materials Clay

Crushing

Fine Grinding in Ball mills and Tube mills Storage basin Channel

Mixing in correct proportions

Preheating @800° by exhaust gases Storage tank for raw mix

Fuel fed from lower end (Coal, oil or natural gas)

Fed to rotary Kiln Clinkers are formed

Addition of 2 to 3% of gypsum Clinkers are ground in Ball mill

Cement silos Packing plant

PROCEDURE OF MANUFACTURE OF CEMENT BY THE WET PROCESS

(a) In this process, the calcareous materials such as limestone are crushed and stored in silos or storage tanks.

(b) The argillaceous materials such as clay is thoroughly mixed with water in a container known as the wash mill and this washed clay is stored in basins.

(c) The crushed limestone from silos and wet clay form basins are allowed to fall in a channel in correct proportions.

(d) This channel leads the materials to grinding mills where they are brought into intimate contact to form what is known as the slurry.

(e) The grinding is carried out either in ball mill or tube mill or both.

(f) The slurry is led to correcting basin where it is constantly stirred.

(g) At this stage the chemical composition is adjusted as necessary.

(h) The corrected slurry is stored in storage tanks and kept ready to serve as feed for rotary kiln.

FLOW DIAGRAM OF WET PROCESS

Calcareous Materials Lime Stone / Argillaceous Materials Clay Crusher/Wash mill

Storage basin(Silos)Channel

Wet grinding mill (Ball mill) to make slurry Blending of slurry to correct composition

Storage of corrected slurry

Fuel fed from lower end (Coal, oil or natural gas)

Corrected slurry fed to rotary Kiln (from upper end) Slurry converted to Clinkers
Addition of 2 to 3% of gypsum Clinkers are ground in Ball mill
Cement silos Packing plant

BURNING

A rotary kiln is formed of steel tubes and the diameter varies from 2.50m to 3.0m Lengths vary for 90m to 120m. Laid at a gradient of about 1 in 25 to 1 in 30. The kiln is supported at intervals by columns of masonry or concrete.
The refractory lining is provided on the inside surface of rotary kiln. It is so arranged that the kiln rotates at about one to three revolutions per minute about its longitudinal axis. The corrected slurry is injected at the upper end of kiln. The hot gases or flames are forced through the lower end of kiln.

Dry zone the portion of the kiln near its upper end is known as the dry zone. And in this zone, the water of slurry is evaporated. As the slurry gradually descends there is rise in temperature and in the next section of kiln, the carbon dioxide form slurry is evaporated. The small lumps, known as the nodules are formed at this stage. These nodules then gradually roll down passing through zones of rising temperature and ultimately reach to the burning zone where e temperature is about 1400° C to 1500° C Burning zone Calcined product is formed and nodules are converted into small hard dark greenish blue balls which are known as the clinkers.

GRINDING

The clinkers as obtained from the rotary kiln are finely ground in ball mills and tube mills. During grinding, a small quantity, about 3 to 4 percent of gypsum is added. Gypsum controls the initial setting time of cement (gypsum acts as a retarder and it delays the setting action of cement). The grinding of clinkers in modern plants is carried out in the cement mill which contains chromium steel balls of various sizes. These balls roll within the mill and grind the mixture which is collected in a hopper and taken in the bucket elevator for storage in silos. The cement from silos is fed to the packer machines and stored in a dry place.

FLOW DIAGRAM OF BURNING AND GRINDING OPERATION OF CEMENT

From storage tanks

Rotary klin

Coal dust

Formation of clinkers

coolers

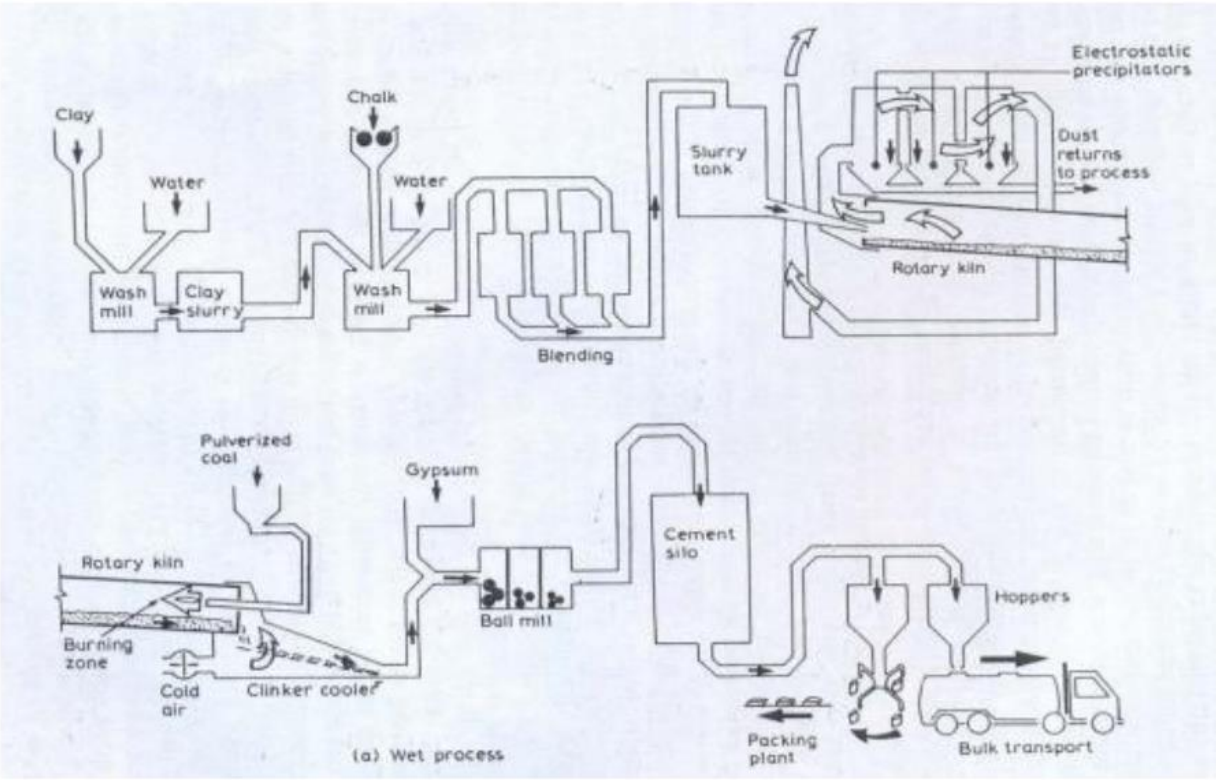
Grinding of clinkers in ball mills and tube mills

Gypsum

Storage in silos

Weighing and packing in bags

Distribution



Packing of cement

Plastic and paper bags are more suitable to protect from air moisture. Packed in 50 kgs

Type of Cement and its standards

Sl.No.	Type of Cement	Reference
1	Ordinary Portland Cement 33 Grade	IS: 269
2	Ordinary Portland Cement 43 Grade	IS:8112
3	Ordinary Portland Cement 53 Grade	IS:12269
4	Rapid Hardening Cement	IS:8041
5	Extra Rapid Hardening Cement	
6	Sulphate Resisting Cemnt	IS:12330
7	Portland Slag Cement	IS:455
8	Quick Setting Cement	
9	Super Sulphated Cement	IS:6909
10	Low Heat Cement	IS: 12600
11	Portland Pozzolana Cement (Calcined based)	IS:1489 P-1
12	Portland Pozzolana Cement (Calcined based)	IS:1489 P-2
13	Air Entraining Cement	
14	Coloured Cement: White Cement	IS:8042
15	Hydrophobic Cement	IS:8043
16	Masonry Cement	IS:3466
17	Expansive Cement	
18	Oil Well Cement	IS:8229
19	Rediset Cement	
20	Concrete Sleeper Grade Cement	IRS-R40
21	High Alumina Cement	IS:6452

Grade of Cement

Grade 33 --as per IS-269 (1989) designated at C-33

Grade 43 --as per IS-8112 (1989) designated at C-43

Grade 53 --as per IS-2269 (1989) designated at C-53

Sleeper cement as per IRS- T40-85 (this will be between C43 and C53) supplied only to railways.