AGGREGATES

Definition

Aggregates are inert materials mixed with binding materials (Cement, Lime or Mud) in the preparation of mortar or Concrete.

CLASSIFICATION OF AGGREGATES

Depending upon the size of their particles aggregates are classified as:

- Fine Aggregates
- Coarse Aggregates
- Cyclopean Aggregates

Fine Aggregates

Particles of fine aggregates entirely pass through 4.75 mm Sieve and retained on o.15 mm Sieve. Most commonly used fine aggregates are Sand, Crush Stone, ash, Surkhi.

1. Sand

It consists of small grains of Silica and is formed by disintegration of rocks caused by weather.
It should have following qualities

- Hard, durable and free from organic coating
- Free from harmful ingredients such as Iron Pyrites, alkalis, salts and coal
- In natural sand or crushed gravel, the amount of clay, fine silt and fine dust should not be more than 4% by weight and crushed stone should not be more then 10%.

Types of Sand

- Pit Sand or Quarry Sand
- River Sand
- Sea Sand

Pit Sand or Quarry Sand

It is found in the deposit of soil and has to be excavated (1 to 2 m). Grains of it are usually sharp and angular. The sand grains are free from salts and does not show Deliquescence (the process by which a substance absorbs moisture from the atmosphere until it dissolves in the absorbed water and forms a solution.). Pit sand is usually red orange in color due to iron oxide. It is widely used in the construction of building due to binding properties

River Sand

Generally composed of rounded particles, and may or may not contain clay or other impurities. It is obtained from the banks and beds of rivers. It is to be washed before using due to coating of clay.

Sea Sand

Sea sand is rounded brown grained found near the sea beaches. It contains salts so washing is needed before using.

2. Crushed Stone

It is obtained by crushing the waste stone to sand particle size. It gives excellent fine aggregates properties.

3. Ash or Cinder

It is obtained from the steam of locomotives and furnaces. Cheap and strong Mortar is obtained with lime.

4. Surkhi

It is well grounded powder obtained by crushing brick. It is used with lime Mortar.

QUALITIES OF GOOD SAND

- Good sand should have coarse and angular grains of pure Silica.
- Good sand should be free from silt, clay or any such salts that may attack the reinforcement.
- Good sand should not contain any organic matter or any hygroscopic matter.

FUNCTION OF SAND IN MORTAR

- It is used as an adulterant to increase the volume of mortar, making it economical.
- It reduces shrinkage and cracking of mortar on setting.
- It helps pure lime to set because it allows the penetration of air which provides Carbon Dioxide required for carbonization and setting of lime.

BULKING OF SAND

It is the phenomenon by which volume of sand fluctuates with the variation in its moisture contents. Surface moisture holds the particles apart causing an increase in volume over the same amount of sands in surface dry conditions. The amount of bulking will depend on the fineness of sand and bulking effect increases with the increase in moisture contents upto certain limits. Finer sands experience more bulking effects as high as upto 33%, against a moisture content upto 8%.

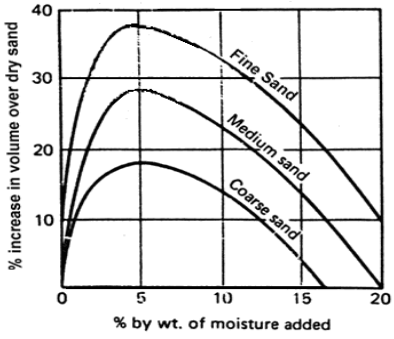


Fig 01: Bulking of Sand

IMPURITIES IN SAND

- Impurities are always undesirable in sands. They reduce the strength of concrete and mortar. Since it is impossible to have sand without impurities. Therefore maximum 6% impurities are permissible.
- Clay, silt, salts, mica and organic matter are sources of weakness in any sand.
- Impurities in sand may also give the dull appearance.
- Clay and silt will prevent the bonding between aggregate particles and cement by making a thin layer around the aggregate particles which reduce the strength.

PROPERTIES OF STONE AGGREGATES

Sand, gravel and crushed stone fall into this category and make up a large percentage of the aggregates used in concrete. Since they generally constitute from 60 to 80 percent of the volume of concrete, their characteristics influence the properties of concrete. They should therefore meet certain requirements if the concrete is to be strong, durable, and economical.

They must be of the proper shape, either rounded or approximately cubical in shape, clean, hard, strong, and well graded. They must possess chemical stability and in many cases exhibit abrasion resistance and resistance to freezing and thawing.

1. SHAPE AND SURFACE TEXTURE

The particle shape and the surface texture of aggregates influence the properties of fresh concrete more than those of hardened concrete. Sharp, angular, and rough aggregate particles require more paste to make good concrete than do rounded ones. Flat, Slivery pieces make concrete more difficult to finish and should be limited to not more than 15 percent of the total. This requirement is particularly important for crushed fine aggregate, since materials made in this way contains more flat and elongated particles.

2. CLEANLINESS OF AGGREGATES

Particles should be free from coatings of clay or other fine material and from organic impurities which may affect the setting of the cement paste. In the case of coarse aggregates, visual inspection will often disclose the presence of such deleterious materials, but where doubt exists, the aggregates should be tested. However, it is not so easy to inspect fine aggregate in the same way, and standard tests may be carried out to determine the amount of silt and organic materials present in the aggregates.

3. AGGREGATE GRADING

Grading, or particle size distribution, is an important feature of aggregates and is determined by a sieve analysis, as specified by ASTM C136. The sieves used included the following sizes:

Nos. 4, 8, 16, 30, 50, and 100 for fine aggregate and 6 in, 3 in, 1½ in, ¾ in, 3/8 in, and No. 4 for coarse aggregate.

Limits are usually specified for the percentage of material passing each sieve, Grading limits and maximum size of aggregates are important because they affect relative aggregate proportions, cement and water requirements, workability, economy, porosity, shrinkage, and durability of concrete. In general, aggregates which conform to the grading limits produce the most satisfactory results.

4. MOISTURE CONTENT OF AGGREGATES

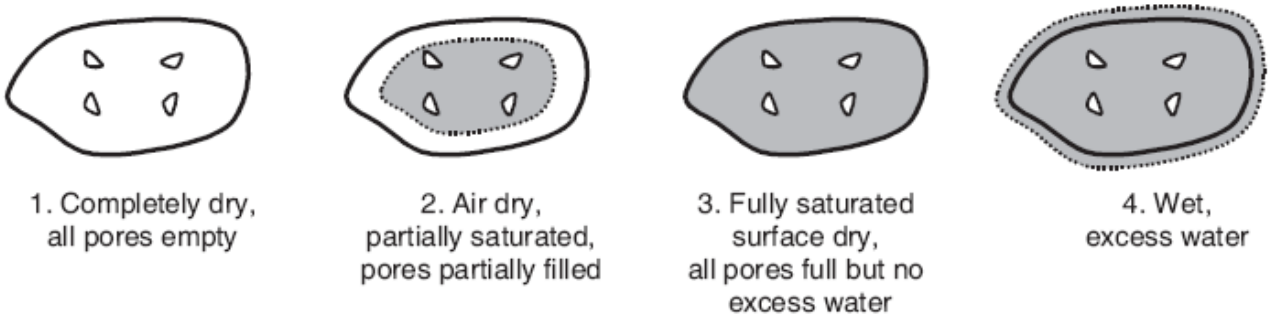
Two types of moisture are recognized in aggregates: absorbed moisture and surface moisture. Absorbed moisture is that which is taken in by the voids in aggregate particles and may not be apparent on the surface, while surface moisture is that which clings to the surface of the particle. The absorbed and surface moisture of aggregates need to be determined in order to control the net water content of a concrete mix and to make adjustments in batch weights of the materials. The moisture conditions of aggregates are designated as follows:

Oven-Dry: In this condition they are fully absorbent.

Air-Dry: Particles are dry at the surface but contain some interior moisture. They are therefore somewhat absorbent.

Saturated Surface-Dry: In this condition there is no water on the surface, but the particle contains all the interior moisture it will hold. It will neither absorb moisture from nor contribute moisture to the mix.

Damp or Wet: The particles contain an excess of moisture on the surface and will contribute moisture to mix.



5. SPECIFIC GRAVITY

The specific gravity of an aggregate is another characteristic of the material which needs to be determined. It is not a measure of aggregate quality but is used in making calculations related to mix design. The specific gravity of most normal weight aggregates will range from 2.4 to 2.9. Test methods for determining specific gravity of both coarse and fine aggregates are described in ASTM C127 and C128.

6. HARDNESS OF AGGREGATES

The hardness of aggregates is expressed in terms of their resistance to abrasion. The characteristic is important if the aggregate is used in concrete intended for such purposes as heavy-duty floors. A common method of making this test is described in ASTM C131 or C535 and consists of placing a specified quantity of the aggregate to be tested in revolving steel drum.

7. STRENGTH OF AGGREGATES

One measure of the strength of an aggregate is its resistance to freeze-thaw. This resistance is an important characteristic in concrete which is exposed to severe weather. The freeze-thaw resistance of an aggregate is related to its porosity, absorption, and pore structure. If a particle of the aggregate absorbs so much water that there is not enough pore space available, it will not accommodate the expansion which takes place when the water freezes and the particle will fail. Freeze-thaw tests on aggregates are commonly carried out on specimens of concrete made with the aggregate.

8. CHEMICAL STABILITY OF AGGREGATES

Aggregates need to be chemically stable so that they will neither react chemically with cement nor be affected chemically by outside influences. In some cases aggregates with certain chemical constituents react with alkalis in cement. This reaction may cause abnormal expansion and resultant cracking of concrete. There are three tests used for testing aggregates for reactivity to alkali: ASTM C227, ASTM C289, and ASTM C586.

COARSE AGGREGATE

- Stone Ballast
- Gravel
- Brick Ballast
- Clinker

CYCLOPEAN AGGREGATES

Size of these aggregates is 7.5 Cm to 15 Cm.

QUARRYING OF AGGREGATES

Quarry

A **quarry** is a place from which dimension stone, rock, construction aggregate, riprap, sand, gravel, or slate has been excavated from the ground. A quarry is the same thing as an open-pit mine from which minerals are extracted. The only non-trivial difference between the two is that open-pit mines that produce building materials and dimension stone are commonly referred to as quarries.

Quarrying

Quarrying is the process of removing rock, sand, gravel or other minerals from the ground in order to use them to produce materials for construction or other uses. So, a quarry is any such working on the surface of the earth where minerals are extracted but quarries are also known by other names around the world: 'surface mine', ‘pit’, 'open pit' or 'opencast mine'.

Quarries in Pakistan

- Margalla
- Sargodha
- Kot Habib Ullah
- Ubhan Shah
- Sakhi Serwer
- Chiniot