

## **:: ARTIFICIAL SAND ::**

Natural sand are weathered and worn out particles of rocks and are of various grades or size depending on the accounting of wearing. The main natural and cheapest resource of sand is river. Dams are constructed on every river hence these resources are erasing very fast. Now a days good sand is not readily available, it should be transported from long distance. Those resources are also exhausting very rapidly. So it is a need of the time to find some substitute to natural river sand.

The artificial sand produced by proper machines can be a better substitute to river sand. The sand should be sharp, clean and coarse. The grains should be of durable material. The grain sizes must be such that it should give minimum voids. The presence of clay and silt retards the setting of the cement and makes the mortar weaker and the walls or the slab leaks and holds dampness.

The sand in the mortar does not add any strength but it is used as an adulterant for economy and with the same it prevents the shrinkage and cracking of mortar in setting. The sand must be of proper gradation ( it should have particles from 150 microns to 4.75 mm in proper proportion) When fine particles are in proper proportion, the sand will have less voids. The cement required will be less when there will be less void in sand. Such sand will be more economical.

Only sand manufactured by V.S.I. Crusher is cubical and angular in shape. Sand made by other types of machines is flaky , which is troublesome in working. There is no plasticity in the mortar. Hence the mason are not ready to work with machine made crushed stone sand. For the same reason inferior river sand may be used. Manufacturing sand from jaw crusher, cone crusher, roll crusher often contains high percentage of dust and have flaky particle. Flaky and angular particles may produce harsh concrete, and may result in spongy concrete.

There is standard specification for Fine aggregates (Sand). It is divided in four gradations. Generally known as Zone I, Zone II, Zone III and Zone IV. There is sieve Designation for each grade. Gradation is made as per the use of the sand. There are testing sieves for testing the sand. A set of Sieves with square hole is available. Followings are the sieves

4.75 mm, 2.365, 1.1830, 600 microns, 300 microns, 150 microns

pan

Specific percentage are designated for each size for each Zone sand in terms of material retained or passed from the sieves.

### **• Zone One Sand :**

Sieve size	Percentage retained	Percentage passing
4.750 10 %	90-100 %	
2.365 40 %	60-95 %	
1.1830 70 %	30-70 %	
600 microns	66-85 %	15-34 %
300 microns	80-90 %	5-20 %
150 microns	90-100 %	0-10 %

### **• Zone Two Sand :**

Sieve size	Percentage retained	Percentage passing
4.750 10 %	90-100 %	
2.360 25 %	75-100%	
1.1830 45 %	55-90 %	
600 microns	41-65 %	35-59 %
300 microns	70-92 %	8-30 %
150 microns	90-100 %	0-10 %

Where concrete of high strength and good durability is required Sand used should be of proper gradation. The concrete mix design should be done properly. When the sand of finer grade is used, the ratio of finer

to coarse aggregates should be reduced. The fine to coarse ratio depends upon the particle shape, surface texture of both fine and coarse particles. The gradation of coarse and fine aggregate is very important. Very fine sand is not recommended for concrete purpose.

The fines content in the sand below 600 microns should be about 30 to 50 %. This will be a ideal sand for concrete work as well as masonry and plaster work.

At present it is generally observed that the fine content in river sand below 600 microns are very less. Such sand should not be used for concreteing work.

Our Rotopactor Produces perfect sand of required gradation. Sand of any Zone can be produced. Sand from our Rotopactor is a perfect substitute for river sand.

The Civil engineers, Architects , Builders, Contractors agrees that the natural sand, which is available today, is deficient in many respect. It do not contains the fine particles, in proper proportion as required. Presence of other impurities such as coal, bones, shells, mica and silt etc makes it inferior for the use in cement concrete. The decay of these materials, due to weathering effect, shortens the life of the work. Now a days, Government have put ban on Dragging sand from River bed.

Due to dragging of the sand ,from river bed reduces the water head, so less percolation of rain water in ground, which result in lower ground water level. In some places it may be up to 600 ft deep. The roots of the tree may not be able to get water. The water flowing in the river may be covered with sand so it is less exposed to Sun. In the absence of sand, so more water gets evaporated due to direct sunlight. The rain water flowing in the river contents more impurities. when it passes through Sand bed it gets filtered. ( In water supply schemes the water is filtered in sand bed only) If there is no sand in river- bed, water will not be filtered. Such water may be harmful for drinking purpose. Due reduced water level in ground, may result in draft, even scarcity of drinking water, so Government have to supply water by tanker. Which is more expensive compared to the royalty collected for sand.

Vastu Shastra: Now a days Vastu Shastra is more popular, followed by so many persons for constructing a house. As per Vastu shastra the Building material must be free from traces of human body or animal body. The River sand contains Bones of human beings and animals. The shells are also one kind of bone. It is not easy to take out all such things present in the river sand. The best solution for this is to use Artificial crushed sand of good quality.

Only the long term substitute for river sand is manufactured sand or crushed sand from V.S.I. Crushers. The manufactured sand must have cubical particles or spherical particles which can be generated only from V.S.I. Crushers only Due to Cleavage crushing. Due to cleavage breaking of the particle the surface is more smooth. Sand manufactured from any other process/ machine can not have cubical shape. Fine aggregates manufactured by Compression crushing ( Jaw crusher, Cone crusher, Roll crusher, Hammer mill ) is flaky and more angular in shape. The surface texture is very rough. There fore such fine aggregate is not suitable for concreting and other construction work. The Plasticity of concrete reduces and results in honey combing.

So the process of manufacturing should be such that it should give Cubical particles. Flaky particles increases voids over cubical or spherical particles about 5 to 6 percent more, and reduces the strength of concrete.

Vertical shaft Impactor principle is used for crushing bigger particles, for shaping the crushed metal (giving better shape of the particle) and for crushing fines aggregates below 4.75 mm. It is best machine for making sand from stone.

Sand manufactured by Vertical Shaft Impactor is of cubical shape. Such sand can be used for all types of construction work, Concreting, Plastering etc and is better substitute to river sand.

V.S.I. Crushers is a most economical machine for Crushing Stone in Cubical shape and manufacturing artificial sand. In this machine the particles are thrown at a high speed, those particles colloid with each other and shatter in cubical particles. A Anvil ring, Shelf ring (pigeon hole ring) are provided to get the particles edges grounded.

The wear cost is a very important criteria in crushing process. Wear cost of other crushing machines such as Roll crushers, Cone crushers, H.S.I. is very high compared to V.S.I. Crushers. It is about four to five times more that of VSI crusher. Rotopactor is a most economical machine for manufacturing artificial sand. In this machine the stone are thrown at a high speed, those particles colloid with each other and shatter in cubical particles. Anvils or Shelf ring (pigeon hole ring) are provided. A rubbing action of particles over pigeon ring, grounds the sharp edges and make the texture smooth.

In our machine a specially designed pigeon ring is provided which uses the residual kinetic energy in the particle and makes it revolve and role and rub with each other in a circular path. This makes the shape of the particles very good, and smooth. The sand manufactured can be of very fine to course grade as per the requirement of the work. The sand manufacturing process is dry. The process requires very less water that too only to settle down the residual dust particles in colloidal state, emitted from the outlet. This machine can allow, slightly wet grit for crushing. Other machines, Cone crusher, H.S.I. could not use wet material, as it clogs the machine.

Our V.S.I. Crushers and Rotopactors are more efficient and more economical in operation. Due to constant development and research our machines are very sturdy and requires very less maintenance. It is the result of our efforts for constant development the wear cost of our machine is least.

### **Comparison of artificial sand with river sand**

Sand manufactured by Vertical Shaft Impactor is of cubical shape. Such sand can be used for all types of construction work, Concreting, Plastering etc and is better substitute to river sand.

Followings are the actual result of Concrete Designed with river sand and Artificial sand. proportions are by weight Mix Design M 15 M 55 concrete is designed for River sand and artificial sand. Results are as follows:

#### **1) With using River sand :**

- Cement one bag ..... 50 Kg
- Sand 135 Kg
- Agg. 20 mm 135 Kg
- Agg. 12 mm 67.5 Kg
- Water 27.5 ltrs

Strength achieved after 7 days curing.....174.81 Kg/Cmsq.

#### **2) With using Artificial sand : Proportions are by weight**

- Cement one bag 50 Kgs
- Sand (artificial m/c made) 125 Kgs
- Agg. 20 mm 137 Kgs
- Agg. 12 mm 75 Kgs
- Water 27.5 Ltrs

Strength achieved after 7 days curing .....186.67 Kg / Cmsq.

Similar test is performed with higher grade Concrete Mix Design M 55 M 55 concrete is designed for River sand and artificial sand.

Results are as follows:

**1) With using River Sand :** All proportions are by weight

- Cement 50 Kg
- River Sand 75 Kg
- Agg. 20 mm 75 Kg
- Agg. 12 mm 37.5 Kg
- Water 19 Ltrs

Strength achieved after 7 days curing .....441 Kg per Sq.cm

**2) With using Artificial Sand :** All proportion are by weight:

- Cement 50 Kg
- Artificial Sand 70 Kg
- Agg. 20 mm 80 Kg
- Agg. 12 mm 35 Kg
- Water 19 ltrs

Strength achieved after 7 days curing .....468.14 Kg per Sq.cm

**Conclusion:**

From the above design results it can be observed that the strength of Concrete increases with Artificial Sand. More over the presence of Fines in artificial sand increases the workability and gives more sound Concrete. The slabs, using Artificial sand, are more leak proof than by river sand.

Now a days, in construction of roads, buildings, dams, canals, etc., cement concrete plays an important role. Concrete is an artificial stone resulting from hardening of rationally chosen mixture of binding material, water and aggregate (Sand and crushed stone or gravel). The mixture of these materials, before it hardens, is called concrete mix. Particles of sand and crushed stone from a stone are car-cass in concrete. Cement paste resulting from the interaction of concrete mix with water coating on the grains of sand and crushed stone, fills the voids between them, lubricates the aggregate and imparts mobility (fluidity) to the concrete mix. When the cement paste hardens, it binds the aggregate into an artificial stone or concrete.

High quality concrete mixture may be produced only with deep knowledge of all manufacturing procedures, a proper choice of quality constituents and their optimum ratio, suitable procedures for preparing concrete mixes, for placing, compacting and hardening them in order to obtain concrete structure of high quality, high strength, durability and low cost.

Concrete is one of the major building materials in all branches of modern construction. Possibility of controlling the properties of concrete within a wide range by using appropriate in gradients. the concrete mix should possess adequate plasticity and can readily be shaped in to durable structural items of various sizes and shapes at no considerable labour expenditure.

The proper sand with requisite fineness module can achieve the above requisite. The natural river sand is a cheapest resources of sand. Natural sand is weathered and worn out particles of rocks and is of various grades or of size. Depending on the account of wearing. But now a days these resources are erasing very fast. Due to dams constructed on every river the natural sand producing capacity reduce to a considerable extent. Due to fast development of the country the consumption of the sand is also increased.

The sand available in the riverbed is very coarse and contains very much percentage of silt and clay. The silt and the clay presents in the sand reduces the strength of the concrete and holds dampness. Fine particles below 600 microns must be up to at least 30% to 50% for good results. At present these particles are not present in river sand up to the required quantity.

The natural river sand is the product of sedimentation. Mica, coal, fossils and other organic impurities are present in the river sand. The increase of these impurities above certain percentage makes the sand useless for concrete work. There is discrepancy in the sand in two trucks lifted from same source. Hence for important work and to achieve the quality each truck of sand should be tested. For getting required fineness module the sand should be sieved. In routine average wastage of sieving are about 35% and extra Labour cost involved.

For this reason to fulfill the requirement of fine aggregate (Sand) some alternative material must be found. In foreign countries alternative to river sand is already in use. Fine cubical particles of stone below 4.75 mm are used, to replace the river sand. But as these particles have sharp edges and rough surface texture, its use in concrete requires some admixtures to increase the plasticity of the wet concrete and mortar. Such machine made sand contains flaky particles, which decreases the workability and requires more water cement ratio. The effect of more water in the concrete reduces its ultimate strength to a substantial amount. Increase in 1% water reduces the strength of the concrete by 5%.

To overcome these difficulties we have developed artificial machine made sand similar to river sand. The sand manufactured by our machine is having good surface texture and edges of the granules of the sand are rounded

The particle shape of fine aggregates is very important for making concrete. Recent tests however have shown that a good quality concrete made from the sand having cubicle particles and sharp edges, gives higher tensile strength. Same way rounded sand particles gives more compression strength to the concrete. So to achieve both the effect it is recommended that the sand particles should be cubicle with grounded edges. Where concrete of high strength and good durability is required, fine aggregates confirming to zone one to zone four may be used. The concrete mix design is very important. The fine aggregates grading becomes progressively finer from zone one to zone four, the ratio of fine aggregates to course aggregates should be progressively reduced. Actual ratio of fine to course aggregates for any particular mix will depends upon the actual grading, particle shape and surface texture of both fine and course aggregates. Use of zone four sand is not recommended for reinforced concrete purpose. Experiments have shown that considerable variation in strength of mortar may occur owing to the form and variety of the sand particles. The strength of mortar may differ by about 50% of average. Sand particles should however be hard for more strength. It is not possible in river sand, that all particles should be of higher strength. This can be achieved only by making sand with the help of machines. In machine made sand we can use the raw material of higher strength. From the above following are the requisites of sand :

- All the sand particles should have higher crushing strength.
- The surface texture of the particles should be smooth.
- The edges of the particles should be grounded.
- The ratio of fines below 600 microns in sand should not be less than 30%.
- There should not be any organic impurities
- Silt in sand should not be more than two percent. Total limit of 5 %.
- In crushed stone sand the permissible limit of fines below 150 microns may be up to 20 %. This does not affects the 5 % permissible limit.