International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017),e-ISSN:2455-2585
International Conference on
Recent Explorations in Science, Engineering And Technology (ICRESET'19)
Volume-5, Special Issue-March, 2019.

Behavioural Study on Treated Sea Sand as a Fine Aggregate in Concrete

*M.Yuvaraaj[1],R.Gokul[2],N.Santhosh[3], R.JAGEDESWARI[4], M.E

[123]UG Students, KGISL Institute Of Technology, Coimbatore, India.

[4]Assitant Professor, Department of Civil Engineering, KGISL Institute Of Technology, Coimbatore, India.

ABSTRACT

In developing countries like India, the need of the essential construction material particularly sand is getting increased; but the availability of source of the sand is very less. The over collection of river sand from river beds affects our ecological cycle directly or indirectly and so instead of river sand, sea sand that is enormously present in nature at sea shores has become common. Only if the concrete has natural aggregates, the strength and durability would be enhanced. In the current scenario, most of the building agencies and MNC companies adopt artificial sand in their projects. Sea sand is less expensive and reduces the overall construction cost, which also helps to protect river sand from being destruction. It is validated using spectroscopy results that incorporation of sea sand adds strength to the structure and can be preferred for any construction purpose.

Keywords: Natural aggregates, Sea sand, Durability, Construction cost, Spectroscopy results.

INTRODUCTION

In this modern era, demand for sand increases and the cost also rise. The continuous grabbing of sand from the beds also leads to scarcity. To overcome this problem, the use of Sea Sand in construction field may be an alternative remedy. The history of using Sea Sand in our country is very short. When Sea Sand is mixed with cement in place of normal River Sand to make concrete for buildings, the high content of chloride in Sea Sand leads to defects in the structure. This composition absorbs humidity which causes erosion and rusting in the steel rods used in reinforced concrete. With the invention of precision instruments, it may be possible in the future to modify the properties of Sea Sand concrete to make it suitable for construction1. An experimental setup is been set up for making Sea Sand suitable for construction purpose by reducing the

salt content to equalize its properties similar to the River Sand. The removal of salt content present in the Sea Sand is mandatory because, it affects the durability and workability of the structure. The scope of the projects is to utilize Sea Sand for the replacement of demand of River sand and to improve the high strength for the concrete. Thus, this study mainly focused on study the strength variations in concrete before and after the removal of salt content from the Sea Sand with respect to compression and compare the different test results on water to determine the hardness.

Origin of the sea sand

At the time of ice age, the sea water level was 120 m lower than today. Day by day due to the movement of tectonic plates, the level has increased and 4000 years ago, the process has ended and the beaches are formed. A main constituent in sea sand is quartz (SiO2), generally formed by volcanic eruptions. SiO2 is extremely hard in nature and do not consist of any carbon content in it. Additionally, sea sand also contains calcite (CaCO3), which has carbon atom. Its advantages are as follows,

- It is more rounded or cubical like river sand
- Available as natural deposit
- Contains no organic contaminant or silt
- Abundantly available
- Can be mined at a low cost

SCOPE OF THE STUDY

The main scope of this study is

- To concentrate on strength and durability of the concrete with replacement of 10mm fine aggregate of sea sand and 20mm coarse aggregate. In this project, the sea sand sample is taken from Vembar, Tuticorin District, and Tamilnadu, India.
- To check the behaviour of sea sand in a concrete cube.
- To check the primary character of concrete element like compressive strength, water absorption, permeability of sea sand concrete cube and to compare with river sand concrete cube.

Materials and Methods

Sea Sand

An extensive assemblage of sand dunes of several types in an area where a great supply of sand is present; characterized by an observer of travel lines are directional indicator and by a wavelike appearance of dunes separated by troughs1. 2.2 Properties of Sea Sand Physical properties of coastal soils are scarce in number. Usually, these properties are studied together with the other soil characteristics. The texture of coastal soils may vary in a wide range from loose sandy deposits to heavy soils. The distribution of size fractions along the profiles of coastal soils is very uneven and rather random. As a rule, sandy layers of coastal soils are structure less and loose, sometimes they are somewhat compacted or rather even dense. Sandy horizons are characterized by a high water and air permeability. Therefore, the aeration of sandy soils is rather good; they are not so strongly affected by water logging as clayey soils. The bulk density of sandy soils is somewhat higher than 1 g/cm3. The water content does not exceed 10-20 %. The bulk density of coastal soils generally decreases from sandy to clayey soils, from mineral to organic soils. Simultaneously, increase in the water holding capacity is observed. The Physical and Chemical properties of sea sand are determined using granular size, pH test, chloride test.

Properties of River Sand

The colour of the sand is Orange yellow and brown. Granular size of river sand is less than 4.75 mm.99.5 % of SiO2 is pure in condition. Al2O3 and Fe2O3 are the impurities present (0.5%). Melting point is (1722 °C) with flux agent it reduces to 1290C2. River sand is uniform in size and also offered in various particle sizes. It has the property of reducing the shrinkage cracks.

Comparison of Sea Sand and River Sand

Sea sand is more stable (high SBC - Safe Bearing Capacity) than river sand. It is due to the fact that sea sand, which is brought by travelling water either pushed by sea shore or by river during the continuous rolling in between water layers in rivers and sea shore (which can be assumed as infinite time process) bigger stone particles continuously decaying during travelling towards sea and dissociates into as small as possible3.

Remaining dissociate particles at beach will be of much strength than any other sand on earth surface. 2.5 Sand Test Different tests were carried out on Sea Sand to determine its properties.

Specific Gravity Test

Specific gravity of solids, Gs is defined as the ratio of the weight of a given volume of solids to weight of an equivalent volume of water at 4C.

Specific Gravity = W2 –W1/ (W4 – W1) – (W3 – W2)

where,

W1 = Weight of empty bottle (kg)

W2 = Weight of soil dried in oven and cooled in a desiccators (300g) and bottle (kg) W3 = Weight of soil, water and bottle (kg)

W4 = weight of water and bottle (kg)

LITERATURE REVIEW

To form concrete by using sea sand, many experts say that if the sea sand is collected from 10 km away from the shore area, then the amount of chloride become less and the collected sand can be adoptable to develop the standard quality concrete [2]. Apart from concrete work, the sea sand may also be used for other constructional works like reclamation and filling during the highway project works. As per the American concrete institute and American coastal department, each individual uses 200 kg of sand annually. So next to water and cement, the need for sand is essential, particularly in civil industry. In the construction industry, 1/3 part is occupied by fine aggregate in the total concrete volume, and without it, concrete production is less possible. The amount of moisture content present in sea sand is nearly about 10% of weight of the total sea sand. It affects the mix ratio while developing the concrete mix design. Hence moisture level must be considered and has to be eliminated from sea sand using water elimination devices like hot air oven. If concrete is considered as an element, then the property of concrete is mainly based upon the constituents present in the concrete. In this project, sea sand is considered as a fine aggregate for concrete formation. So the properties of concrete like shrinkage, creep, unit weight, young's modulus, surface friction, thermal properties, etc. depend on the sea sand properties. Hence it is necessary to focus on material study apart from elemental study. [3] A recent survey has informed that Cochin port trust, plans to dredge out 70,000 m3 of sand slurry daily and 8 Mt of sand annually. Shell content reduces workability and strength, whereas chloride content reduces durability and strength. So these two components must be eliminated from sea sand to attain better quality concrete. If we construct a structure using steel RCC, then the chloride content in cement must be limited to 0.1% (As per IS 456:2000). If the limit exceeds, then it destroys the alkaline coating present in the steel surface leading to the formation of rust due to increase in the volume of steel reinforcement. Thus, the reinforcement loses its stability, which automatically makes the entire element to lose its load bearing capacity. Finally the entire system collapses indicated by certain warning. The sea sand containing free chloride ion would be washed away by keeping it under natural rainfall for a period of 1 year. But this is not suitable for the sea sand in which the chloride ions are physically or chemically bounded with it. In such cases, an additional requirement is needed. It has been established through the process of wet sizing and attrition scrubbing, in which the amount of chloride can be reduced from 500 ppm to 100 ppm. Ponnani, the area located in Kerala at which the sea sand treatment is going successfully under large working area with lot of human resources, and the treated sea sand is transported to ready mix concrete plants. All these relevant works are done by the directorate of ports. After obtaining the ready mix concrete plants, the chemical engineers add small quantity of admixtures to remove the effect of minimum amount of chloride ion and check with the standard value, and finally the prepared concrete plants are supplied to nearby contractors. Through this activity, the Kerala government has made 2300 employment opportunities both directly and indirectly. Depending on the past ratio average of cement consumption in the country, the expected requirement of sand at 2020 will be about 600650 Mt. [4] The melting point of sea sand is 1722 , but it can be reduced to 12900 by adding flux. Sea sand has high Safe Bearing Capacity (SBC). [5] Silica fume, blast furnace slag, fly ash can be used to improve the lifespan of sea sand concrete in which the pore volume can also be reduced by the silica fume. [6] Unwashed sea sand and water improves the density of concrete when compared to normal concrete. In addition to these added mixture, admixture consisting of calcium nitrate is also added to improve durability of sea sand concrete. Table 1 shows the summation of these results. Corrosion rate has been delayed using epoxy-coated steel bars, stainless steel bars, and carbon fiber rods. Permeability co-efficient gets reduced due to density of microstructure. [7] 50% replacement of sea sand concrete does not affect its strength, but [8] 40% is considered to be the maximum limit. [9] Shell content size of fine aggregate does not exceed 5 mm since it causes not only corrosion but also results in efflorescence that acts as a water absorbing agent.

RESULTS & DISCUSSION

Specific gravity and fineness modulus of sand

Specific gravity is an important parameter during the mix design calculation of concrete. Quantity of the concrete depends mainly on the density of these constituent materials, which in turn depends on the specific gravity of the constituents. In order to achieve better quality of concrete mix it is essential to found out the specific gravity exactly. Table 1 shows the sand properties.

Table 1.Sand properties

Property	Value
Fineness modulus of River sand	2.48
Fineness modulus of Sea sand	3.80
Specific gravity of M- sand	2.60
Specific gravity of river sand	2.65
Specific gravity of sea sand	2.70
Specific gravity of coarse aggregate	2.80
Specific gravity of mixture of sand	2.65

Compressive Strength of Concrete Cubes

The sea sand which is taken from the Nagapattinam Region is used in the entire process. The sea sand is tested for compressive strength without the removal of salt content. The compressive strength of concrete (full replacement of river sand by sea sand and partially replaced river sand) has increased at 7, 14, and 28 days is presented in Table 5. Even though the sea sand attains high compressive strength the usage is not as frequent as River sand since, it leads to corrosion and the durability of the structure is not long lasting.

Compressive Strength of Mortar Cube

After the removal of salt content by using our Experimental Setup the compressive strength of the mortar cube is determined. The test result shows the Purified Sea sand has more strength than the unpurified Sea Sand and River Sand. Hence, it is proved that the corrosion is controllable.

Other Test Results

The EDTA test, Chloride test carried out on various water samples (Potable Tap Water, Distilled Water, Rinsed Water in Sea Sand) shows the salt content.

Chloride test

The durability of the concrete and RCC structures depends mainly on chloride present in the ingredients. According to IS 3025 (part 32), the acceptable limit for chloride content in concrete and RCC structures should not exceed 2000 ppm and 500 ppm respectively. Even the presence of 1 ppm chloride affects the durability which is impossible to remove it completely, but can be reduced by chemically treated technique using NAOH solution. The experimental value of table 4 points out that, the sea sand initially contains 1500 ppm of chloride and after washing with water, it is found to be 450 ppm. To reduce further, the chemical treatment is preferred which reduces the chloride content to 50 ppm. The types of chlorides present in sea sand are termed as free chlorides and chemically bounded and physically bounded chlorides. Free chloride can be eliminated using normal distilled water wash. Chemically bounded chloride can be removed using certain chemicals, while the physically bounded chlorides require pressure and hot condition to get removed. This project improves the lifetime of the building using sea sand with reduced chlorine content by washing with water, thereby satisfying the condition of codal provisions.

CONCLUSION

The replacement of river sand by sea sand overcomes the future demand in the requirement of the river sand in construction. The purified sea sand has more strength than the unpurified sea sand and river sand. Hence, it is proved that the corrosion is controllable. This this project concluded that the removal of salt content from sea sand is mandatory for improving the workability and durability of any construction works

REFERENCES

1. Sukumaran PV, Unnikrishnan E, Gangadharan AV, Zaheer B, Abdulla NM, Kumaran K, Ramachandran KV, Hegde SV, Maran N, Bhat KK, Rao MK, Dinesh AC, Jayaprakash C, Praveen Kumar P, Shareef NM, Gopalan CV. Marine sand resources in the south-west continental shelf of India. Indian Journal of Geo-Marine Sciences. 2010; 39(4):572–78.

2. Sai Deepak W, Tirupathi Naidu G. Effect on Compressive Strength of Concrete using sea sand as a partial replacement for fine aggregate. International Journal of Research in Engineering and Technology. 2015; 4(6):572–78.