

Experimental Investigation on Concrete Using Sea Sand as Fine Aggregate

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ABSTRACT: The main motive of this project is to utilize the sea sand as fine aggregate in concrete for construction after the removal of chloride content from the sea sand. The corrosion making properly that called chloride content can be eliminated from the sea sand by using sand washing process. The concrete cubes and cylinders were casted and then the compressive strength, split tensile strength could be tested after curing duration for 7, 14 and 28 days. The scope of the project is used sea sand as fine aggregate in concrete.

KEYWORD: Chloride content, solubility, river sand, sea sand, compressive strength, split tensile strength.

I.INTRODUCTION

In construction field all kinds of buildings are constructed by using concrete. These concrete materials are basically made by the combination of cement, fine aggregate, coarse aggregate and water with particular ratio. Mostly using fine aggregates are river sand, M-sand and other industrial waste. The continuous grabbing of river sand from the river bed causes the demand of water. This may create the famine.

To overcome this problem the sea sand used as fine aggregate in concrete. The main drawback of sea sand is the presence of large amount of chloride content in it. When it is used in reinforcement it may creates corrosion. To avoid this problem the chloride content from the sand would be removed by required process.

The scope of the project is utilize the sea sand used in construction to increases the durability and workability of concrete. Thus, this investigation mainly focused on the strength variations in the concrete for conventional concrete and sea sand concrete from the different test results.

II.PROPERTIES OF SEA SAND

Sea sand can be used in concrete when regular sand is not available easily. The main worry is about the durability related properties as the sea sand has large amount of salt adhered on the surface. Just water washing could not remove all deleterious material firmly adhered on to the surface. Pressure washing and chemical washing remove all such materials. Sea sand is fine and smooth compared to river sand. It will have influenced on the mechanical properties of concrete.

For producing low to medium strength concrete, there may not be significant difference in the properties. For special concrete, the river sand should be characterized before use. Chlorine induce corrosion in RCC is a main problem. Sea sand has no serious problem in plain and non structural concrete applications.

III.SAND TEST

The properties of sea sand could be determined by following test.

i) SPECIFIC GRAVITY TEST:

The specific gravity is defined as the ratio of density of a substance to the density of the reference substance, equivalently; it is the ratio of the mass of the substance to the mass of a reference substance for the same given volume.

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Specific gravity = $(w_2 - w_1) / (w_4 - w_1) - (w_3 - w_2)$

Where,

w_1 = weight of empty bottle (kg)

w_2 = weight of soil dried in oven and cooled in a desiccators and bottle (kg)

w_3 = weight of soil, water and bottle (kg)

w_4 = weight of water and bottle (kg)

This specific gravity test can be conducted by using pycnometer. It has no unit.

Specific gravity = density of the object / density of water

ii) pH TEST:

The alkalinity or acidity of a solution or suspension is usually expressed in terms of pH. Technically pH is a symbol which can be defined as the reciprocal of the logarithm of the hydrogen ion concentration. It can be determined by using pH meter.

iii) SIEVE ANALYSIS:

A sieve analysis is also called as a “graduation test”. It is a practice or procedure used to access the particle size distribution of a granular material.

The size distribution is often of critical importance to the way the material performs in use. According to Indian standard code IS 460-1962 (revised), the sieve number is the mesh width expressed in mm for large sizes and in microns for small sizes. The set of IS sieves for fine sieve analysis consist of 2.36mm, 1.18mm, 600 μ , 425 μ , 212 μ , 150 μ and 75 μ sieves. In the sieves analysis process, the sea sand of 1kg is taken for test and is sieved through a selected set of sieves arranged according to their sizes. The largest arranged according to their sizes. The largest sized sieve at the top and the smallest sized sieve at the bottom. A receiver is kept at the bottom and lid is placed on the top most sieve of the stack. The shacking process can be done by using mechanical shaker. The amount of soil retained on each sieve is weighted to the nearest 0.1g. On the basic of the total weight of the sample taken and the weight of soil retained on each sieve the percentage of the total weight of the soil passing through each sieve can be calculated.

iv) CHLORIDE TEST:

For determining the water soluble chloride in soil, in this method soluble chloride ions in the sand sample were precipitated by adding AgNO_3 and the resultant AgCl . Precipitate was titrated to calculate the excess AgNO_3 using $\text{K}_2\text{Cr}_2\text{O}_7$ indicator yellowish color solution is formed. Titrate into the AgNO_3 precipitate and shack well. Brownish yellow color is formed.

Chloride = normality \times volume of burette solution / 20

- The amount of chloride content in river sand is 46gms per lit.
- The amount of chloride content in sea sand is 193.25gms per lit.

v) BULK DENSITY:

Bulk density is the property of powders, granules and other divided solids, especially used in reference to mineral components (soil, gravel), chemical substances, (pharmaceutical) ingredients food stuff ,or any other masses of corpuscular or particulate matter. It is defined as the weight of many particles of the material divided by the total volume they occupy. The total volume includes particle volume, inter-particle void volume and internal pore volume.

- Percentage of bulking of river sand = 10%
- Percentage of bulking of sea sand = 14%.

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IV.SALT REMOVAL TEST ON SEA SAND

i) SIMULATED RAIN TEST:

Simulated rain test fresh water was allowed to percolate sand through a specially made apparatus out water soluble chlorides and salt content was measured at time intervals. It was found that by continuous controlled percolated of water leaches out 0.13% of salt content but the salt removal required large volume water and depends on the area of cross section of the apparatus used.

ii) MECHANICAL WASHING:

Washing of sand was done by mechanical agitation. Influence of temperatures on solubility, the sea sand was washed with hot water to remove salt content. It is about 1.11% of chloride content by weight of sand was removed. Influence of temperature on solubility. The chloride content removal was 1.29% by weight of sand.

V.SPECIMEN MAKING

Strength development characteristics of concrete made with sea sand fresh concrete properties such as slump flow, VEE-BEE consistometer were determined. According to an Indian standard specification on IS:1199-1959. The 150mm concrete cubes were caste for compressive strength and 150mm×300mm cylinders for split tensile strength after required period of curing, the specimen were taken out of the curing tank and their surface were wiped of the various test performed were compressive strength test of cubes (150mm side) and split tensile strength of cylinder (150mm×300mm) at 7, 14, and 28 days as per code IS:5116-1959.

Durability characteristics of concrete made with sea sand abrasion. The abrasion test result show that the loss of particles was lower in specimens containing sea sand. Accessible pores the replacement of river sand by sea sand did not produce any significant change in the accessible pores regarding of the replacement rate. The values found in the literature review that the initial surface absorbsion results should no significant difference between mixture with sea sand and the control mixture made with natural sand



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VI.RESULT ANALYSIS

i. COMPRESSION TEST ON CUBE

a) Compression test result for M25 grade concrete (Conventional concrete)

Conventional concrete	Compressive strength(N/mm ²)	
7 days strength	19.31	20.16
	20.25	
	20.92	
14 days strength	26.74	26.26
	25.62	
	26.41	
28 days strength	31.40	31.33
	31.62	
	30.98	

The average compressive strength of conventional concrete is 25-26N/mm².

b) Compression test result for M25 grade concrete (Sea sand concrete)

Sea sand concrete	Compressive strength(N/mm ²)	
7 days strength	17.36	17.77
	17.52	
	18.45	
14 days strength	25.96	25.79
	25.43	
	25.99	
28 days strength	30.42	30.06
	30.05	
	29.72	

The average compressive strength of conventional concrete is 24-25N/mm².

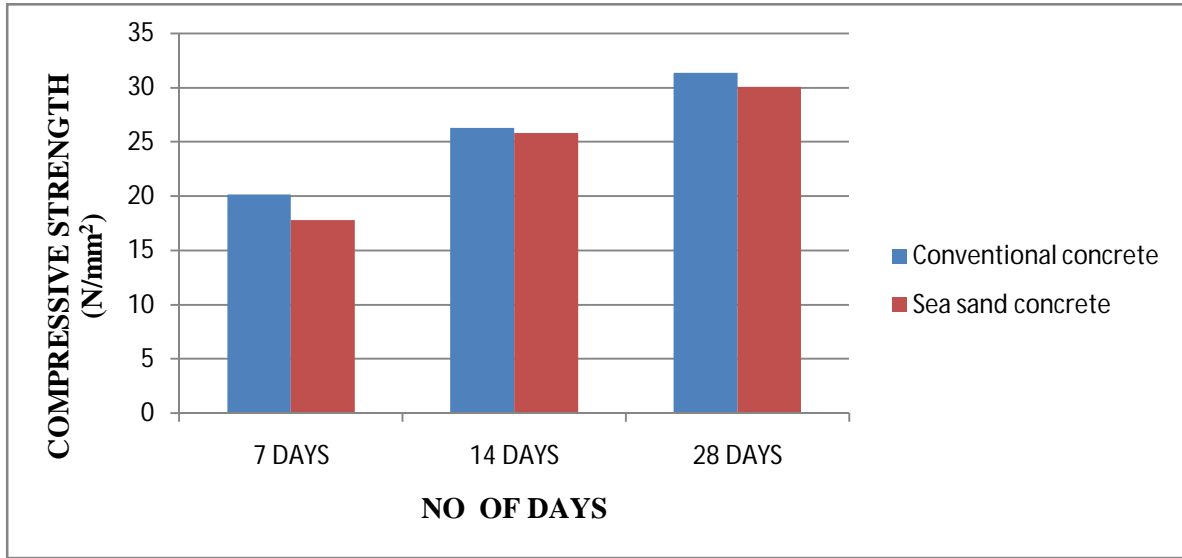


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Compression test result (bar graph)

ii. TENSILE TEST ON CYLINDER

Split tensile test result for M25 grade concrete (Conventional concrete)

Conventional concrete	Tensile strength(N/mm ²)	
7 days strength	1.92	1.83
	1.84	
	1.73	
14 days strength	2.67	2.71
	2.82	
	2.65	
28 days strength	3.26	3.31
	3.48	
	3.19	

The average split tensile strength of conventional concrete is 2-3N/mm².



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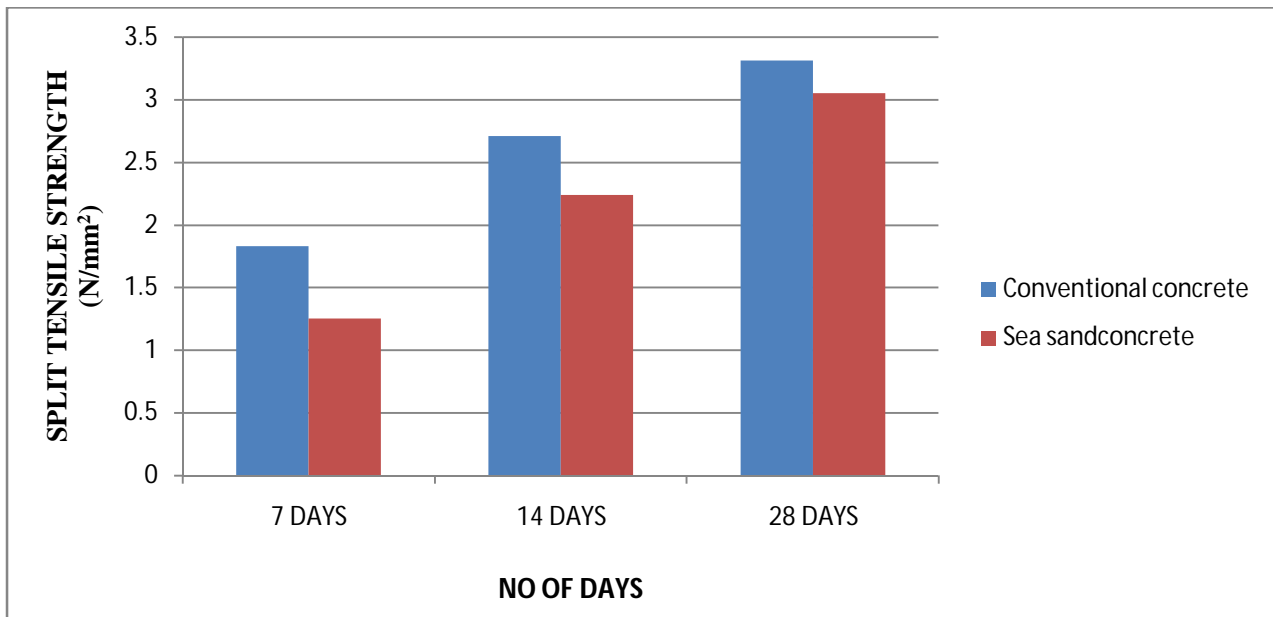
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Split tensile test result for M25 grade concrete (Replacement concrete)

Sea sand concrete	Tensile strength(N/mm ²)	
7 days strength	1.19	1.25
	1.24	
	1.32	
14 days strength	2.31	2.24
	2.19	
	2.23	
28 days strength	3.13	3.05
	2.99	
	3.04	

The average split tensile strength of replacement concrete is 2-2.75N/mm².



Split tensile test (bar graph)

VII.CONCLUSION

This work deals with the usage of sea sand in the construction field with the removal of salt content from sand. After the purification of the sea sand using sand washing process many tests are conducted on the sand and. Fully mixing of purified sea sand attains adequate strength at 28 days. 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. Hence, it is investigated that the corrosion is controllable. This project concluded that the removal of salt content from sea sand is mandatory for improving the workability and durability of any construction works.



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