EXPERIMENTAL ANALYSIS BY USING SEA SAND AS A REPLACEMENT OF FINE AGGREGATE

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ABSTRACT:

Concrete is normally developed using river sand as fine aggregate but overuse of the material has led to environmental concerns, the depleting of securable river sand deposits. Day by Day, the cost of river sand is increasing due to the scarcity and restrictions. Huge quantity of sand excavated from river bed destroys the stability of river banks. To avoid such situation and to meet the demand we have to think of an alternative or replacement material to river sand. Therefore, it is desirable to obtain cheap, environmentally friendly substitutes for river sand that is preferably sea sand. 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, it is used in concrete for the construction purpose. And also Micro Silica (silica fume) is added as an admixture to the concrete which increases the strength of the concrete. As a result it conformed that the compressive strength and the split tensile strength of the sea sand concrete is nearer to the river sand concrete. The replacement of sea sand gave satisfactory results when compared to river sand.

Key words: Sea sand, Micro Silica, Compression Test, Split Tensile Test, Durability Test

1. INTRODUCTION:

With the new freedom enjoyed after twenty five years of the civil war, the construction sector has boomed with increasing demand for raw materials. Quarry dust is one of the alternative raw material for the construction industry, but most contractors and the house owners are not showing any interest in using quarry dust for their construction. According to the industry sources, the price level of the river sand has skyrocketed. This sand is taken from what are essentially non-renewable resources. The Land Reclamation and Development Board plans to popularize the use of sea sand as an alternative to river sand. The price of river sand has increased by over 40 percent consequent to the ban imposed on river sand mining. Due to the government restrictions/regulations on the removal of river sand, the construction industry faces lots of difficulties to obtain river sand in time. According to the Board's sources, the washed sea sand is ideal for concrete and plastering activities. The scope of the project is to utilize the sea sand used in construction to increase the workability and durability of the concrete. This analysis mainly focused on the strength variations in the concrete for conventional concrete and sea sand concrete from the different test results. The results showed that compressive strength and split tensile strength of concrete, made with micro silica was higher. Such concrete could be used successfully in structural applications with economic and environmental advantages. Hardened concrete

containing 10% micro silica will have higher strength and reduced permeability thus providing a more durable concrete with a longer life. Micro Silica is chosen to increase the cohesiveness among the ingredients of concrete.

2.MATERIALS:

The mix proportion of the concrete was M_{25} grade. The cement used for making concrete was ordinary Portland Cement of grade 43. The size of coarse aggregate used for concrete was 20 mm. Sea sand for this project work was collected from Adhirampattinam. Specified concrete grade involves the economical selection of relative proportion of cement, fine aggregate, coarse aggregate and water. Although compliance with respect to characteristic strength is the main criteria for acceptance, it is implicit that concrete must also have desired workability in the fresh state and durability in hardened state.

2.1 SEA SAND:

Sea sand is fine and smooth compared to river sand, it is the cheapest form of fine aggregate. It is more rounded or cubical like river sand. As it is found in natural deposits, grading of sea sand is generally good. 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. If chloride content is high, it can be reduced to acceptable limits by washing with water.

2.2 MICRO SILICA:

Micro Silica, also known as Silica Fume, is an amorphous polymorph of silicon dioxide. It is an ultrafine powder collected as a by-product of the silicon and ferrosilicon alloy production and consists of spherical particles with an average particle diameter of 150 nm. The main field of application is as pozzolanic material for high performance concrete. Silica fume is an ultrafine airborne material with spherical particles less than 1µm in diameter. This make s it approximately 100 times smaller than the average cement particle.

3.TEST OF SAND:

3.1 SALT REMOVAL ON SAND:

Influence of temperatures on solubility, the sea sand was washed with hot water about 5 hours at high temperature to remove the salt content from the sand. The removal of salt on sea sand requires large volume of water.

3.2 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 is determined by using pH meter.

3.3 BULK DENSITY TEST:

Bulk density 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 sea sand = 8.1%

Bulking of sand is allowable to maximum 10%

4. TEST ON CONCRETE:

4.1 FRESH CONCRETE TEST:

4.1.1 SLUMP CONE TEST:

This test was carried out for measuring the workability of the concrete. Height of the cone and the height of the slumped concrete were measured.

- Slump of the concrete is measured as 70 mm.

4.1.2 COMPACTION FACTOR TEST:

The compaction factor test also used to measure the workability of the concrete. Measuring the weight of empty cylinder as W, Weight of partially compacted concrete as W_1 and Weight of fully compacted concrete as W_2.

- The value of compaction factor is 0.91

The compaction factor values can be ranges from 0.7 to 0.95

4.2 HARDENED CONCRETE TEST:

SPECIMEN MAKING:

M_{25} concrete were made with 10% of micro silica and mixed properly. The water cement ratio as 0.50. The specimens were casted and demoulded after 24 hours and were cured in curing pond till the date of testing. The following tests are carried out to ascertain strength of concrete:

Compressive Strength (cube strength)

Tensile Strength (split tensile strength of cylinder)

4.2.1 COMPRESSION TEST ON CUBE:

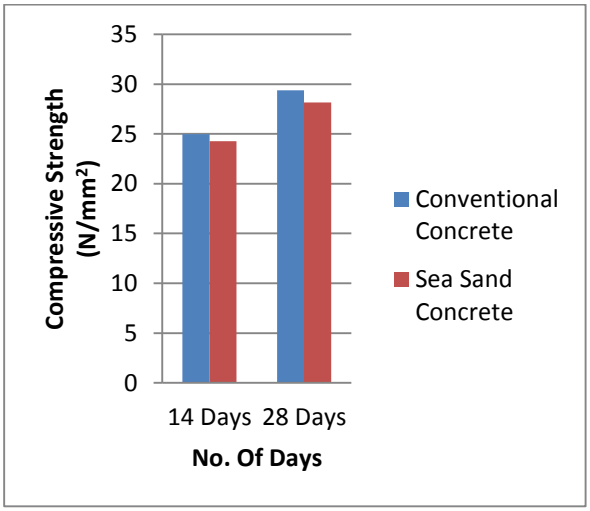
a) Compression test result for M_{25} grade concrete(Conventional Concrete)

Conventional Concrete	Compressive Strength (N/mm^2)	
14 Days Strength	25.55	24.96
	24.22	
	25.11	
28 Days Strength	29.3	29.39
	28.11	
	30.77	

b) Compression test result for M_{25} grade concrete(Sea Sand Concrete)

Sea Sand Concrete	Compressive Strength (N/mm^2)	
14 Days Strength	22.22	24.26
	24.89	
	25.67	
28 Days Strength	26.66	28.14
	30.22	
	27.56	

TESTING OF CUBE



4.2.2 TENSILE TEST ON CYLINDER

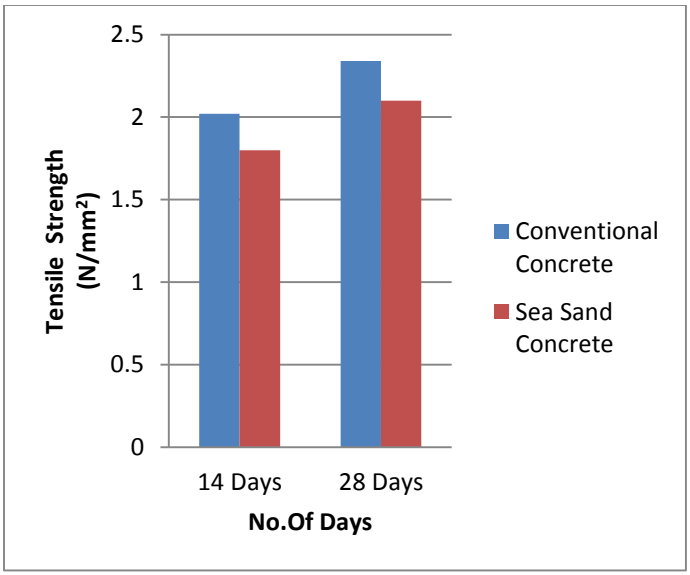
a) Split tensile test result for M_{25} grade concrete (Conventional Concrete)

Conventional Concrete	Compressive Strength (N/mm^2)	
14 Days Strength	1.56	1.63
	1.49	
	1.84	
28 Days Strength	2.12	2.07
	2.12	
	1.98	

b) Split tensile test result for M_{25} grade concrete (Sea Sand Concrete)

Sea Sand Concrete	Compressive Strength (N/mm^2)	
14 Days Strength	1.42	1.6
	1.7	
	1.7	
28 Days Strength	1.42	1.8
	1.98	
	1.98	

TESTING OF CYLINDER



5. Test On Durability:

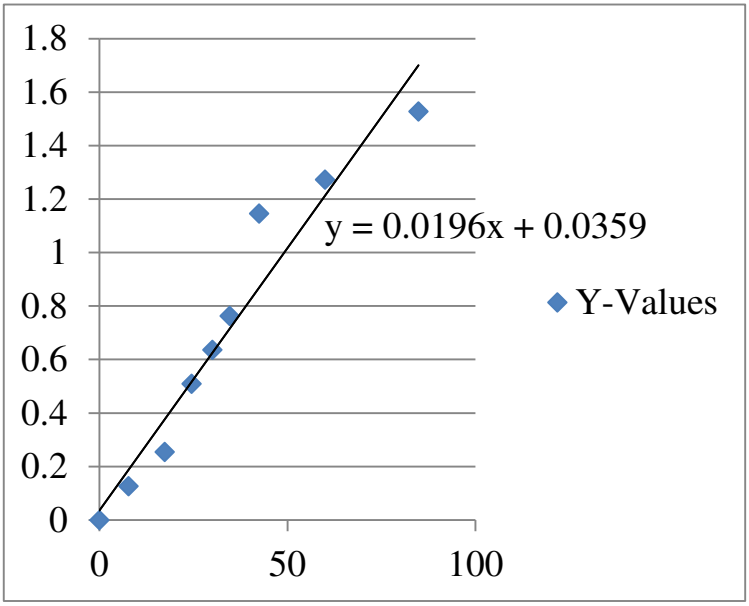
5.5.1 Water Sorptivity Test:

The durability of concrete largely depends on the ease with which fluids enter and move through the matrix. Deterioration due to chloride ions from deicing salts is caused by the transport of a chloride solution into the material. The sorptivity will depend on the initial water content and its uniformity throughout the specimen under test. There is an increase in the mass of the specimen caused by the filling of the open surface pores.

SPECIMEN AND SETUP FOR DURABILITY

Sorptivity Values for Normal Concrete

Time (s)	√T	Q (mm³)	A (mm²)	Q/A (mm)
0	0	0	7854	0
60	7.74	1000	7854	0.127
300	17.32	2000	7854	0.255
600	24.49	4000	7854	0.509
900	30.00	5000	7854	0.637
1200	34.64	6000	7854	0.763
1800	42.42	9000	7854	1.146
3600	60.00	10000	7854	1.273
7200	84.85	12000	7854	1.528

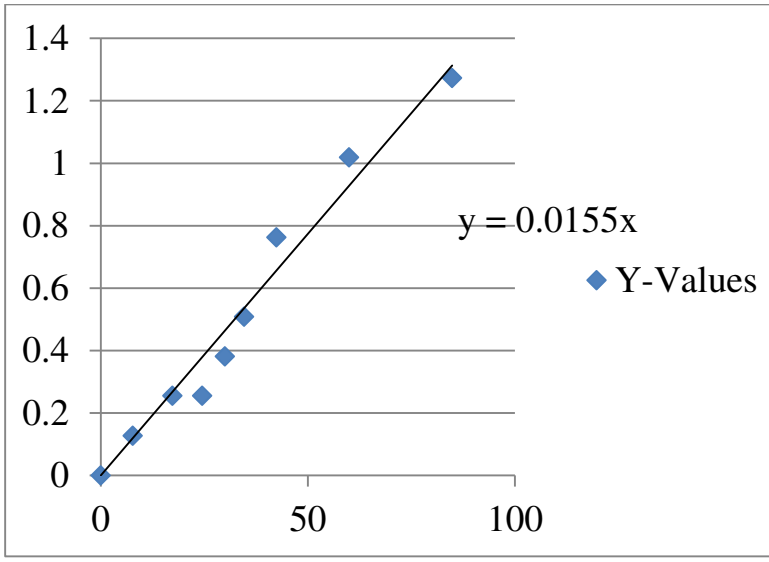


Penetration depth Vs Time for Normal Concrete

Figure shows that for conventional concrete specimen, the sorption coefficient, as given by the slope of the trend line is 1.9×10^{-2} mm/s$^{1/2}$. This is an indication of its durability characteristics

Sorptivity Values for Sea Sand Concrete

Time (s)	√T	Q (mm³)	A (mm²)	Q/A (mm)
0	0	0	7854	0
60	7.74	1000	7854	0.127
300	17.32	2000	7854	0.255
600	24.49	2000	7854	0.255
900	30.00	3000	7854	0.382
1200	34.64	4000	7854	0.509
1800	42.42	6000	7854	0.763
3600	60.00	8000	7854	1.019
7200	84.85	10000	7854	1.273



Penetration depth Vs Time for Sea Sand Concrete

From the figure it is observed that, for the replacement of sea sand with 10% of micro silica, the sorption coefficient was within the acceptable values and even lesser than that of conventional concrete. Thus indicates a good durability nature of sea sand with micro silica.

5. CONCLUSION:

The experiments done on strength characteristics of concrete using sea sand and an admixture(Micro Silica). Sea sand can be transformed into fine aggregate. This work deals with the usage of sea sand in the construction field with the removal of salt content from sand with micro silica. After the purification of the sea sand using sand washing process, many tests are conducted on the sand. Compressive and split tensile strength of sea sand concrete is less than the conventional concrete. Micro Silica was used in the concrete with sea sand as an admixture and it results in higher strength. In M_{25} grade of concrete with 10% of micro silica gave more strength. Hence it is investigated that the corrosion is controllable because the alkalinity is within the acceptable limits. This project concluded that the removal of salt content from the sea sand is mandatory for improving the workability and durability of any construction works. So, use of sea sand in concrete with micro silica as an admixture for minor and massive structures can be encouraged.

6. REFERENCES:

1. M.Karthikeyan and V.Nagarajan, Feasibillity study on utilization of marine sand in concrete fror sustainable development, vol. 45(2), February 2016, pp 313-318.
2. Ahmed M. Ashteyat, Muhannad Ismeik and Khaled Z. Ramadan, Strength development models of concrete with silica fume as fine aggregate replacement material, volume 12 issus 2 version 1.0, May 2012.
3. BS 882, (1992) Specification for aggregate from natural sources of concrete, British Standards Institution, London.
4. N.P. Ratnayake, U.G.A. Puswewala, S.P. Chaminda, E.M. Ekanayaka and M.N. Jayawardene, Evaluation of the potential of sea sand as an alternative to river sand for concrete production in Sri Lanka, vol 16(2014),109-117.