AES

ISSN: 2096-3246
Volume 54, Issue 02, December, 2022

Special Issue

SEA SHELL AS REPLACEMENT FOR FINE AGGREGATE IN CONCRETE PRODUCTION

J. Balaji Praveen
Dhanalakshmi Srinivasan College of Engineering, Coimbatore, Tamil Nadu, India
balajipraveen8493@gmail.com

Sunil Kumar
Babu Banarasi Das University, Lucknow (U.P.) India

Abstract— The overall demand of concrete per year is 11.5 billion tons. This means that, in addition to 1.5 billion tonnes of cement, the concrete industry is consuming annually 9 billion tonnes of sand and rock together with one billion tonne of mixing water. One of the major challenges, with the environmental awareness is exhaustion of river sand resources due to massive consumption. If adequate and reliable sand resources cannot soon be found economic development is bound to be affected. Inconvenient transportation raises the cost of river sand resources. In the present work, literature on the use of sea shell as replacement of fine aggregate has been studied. Various mechanical properties such as compressive strength and split tensile strength are determined at 7, 14 and 28 days along with durability tests at 28 days. Comparative strength development of sea shell mixes in relation to the control mix i.e. mix without SEA SHELL was evaluated.

1. INTRODUCTION

Concrete is a mixture of aggregates, cement and water. The purpose of the aggregates within this mixture is to provide a rigid skeletal structure and to reduce the space occupied by the cement paste. Both coarse aggregates and fine aggregates are required but the proportions of different sizes of coarse aggregate will vary depending on the particular mix required for each individual end use.

1.1 Advantages of sea shell

It is available in abundance. It is the cheapest form of aggregate. It contains no harmful salts. Grading of river sand is good.

1.2 Disadvantages of sea shell

Fluctuations in prices are greater depending on presence of rain and floods. Due to over exploitation, it may not be abundantly available in the future. It may lead to efflorescence and corrosion of reinforcement. If washing is done, it may increase the price further. At present sea shell is not used in India, even if it is found satisfactory there will be considerable initial resistance.

2. LITERATURE

Bayyinah Salahuddin (2018) has reported that over 110 million m3 of sand and 7 million tons of rocks were used for the construction of the Palm Jumeirah.The first and the smallest of the Palm Islands. The sand was dredged from the bottom of the Arabian Gulf in an area about 25 kilometres offshore of one of Dubai‟s ports. Placed end to end, the construction material could have formed a wall 2 m high and 0.5 m thick, circling the earth three times.

Mohd Syahmi Hafiz (2017) has concluded that the treated sea shell can be used as a replacing material for river sand. With sand/cement ratio as 1:3 concrete blocks could be manufactured.

Y. Huiguang et al (2011) has reported that the resistance of sea-sand mix to chloride ion penetration is greater than that of mix containing ordinary river-sand. Since the mud and clay content of sea shell is lower than that of river-sand the fewer clay particles attached to the sea-sand surface increase bonding between cement and aggregate.

3. OBJECTIVE

To find out the suitable method to reduce the salinity in the sand to the permissible level and to study the properties of concrete made with sea shell. An attempt has been made to find the optimum replacement percentage of sea shell with river sand.

4. EXPERIMENTAL PROGRAMME

The experimental program was to study the workability, compressive, split tensile and flexural strength. These properties are studied from mix M20. The schemed experimental program is given in Table.

S.No	TYPE	SPECIMEN	
		CUBE	CYLINDER
1	RS 100 (100 % RIVER SAND)	9	9
2	SS 100 (100 % SEA SHELL)	9	9
3	SS 80 (80 % SEA SHELL)	9	9
4	SS 60 (60 % SEA SHELL)	9	9
5	SS 40 (40 % SEA SHELL)	9	9
6	SS 20 (20 % SEA SHELL)	9	9

The size of specimens are as follows

- Cube is 100*100*100 mm
- Cylinder is 100 mm dia 200 mm length

5. MATERIALS USED & PROPERTIES

5.1 Cement: Portland Pozzolana Cement (53 MPa) conforming to Indian standard specifications IS: 1489-1991 was used. Consistency was 27%, specific gravity was 3.56 and fineness as per specific surface of cement was 354 m2/kg.

5.2 Fine aggregate:

RIVER SAND

In the present study locally available Karur river sand confirming to IS-383:1970 was used as fine aggregate. Its range in size from less than 0.15 mm to 2.36 mm. Fineness modulus and specific gravity of the sand are 3.0 and 2.6 respectively. The fineness modulus has been found as 3.06.

SEA SHELL

In this study sea shell has been collected from Tuticorin was crushed and used. The appearance of the sand is a lot whiter than regular river sand. The fineness modulus has been found as 2.39.

5.3 Coarse aggregate: The coarse aggregate satisfying IS: 383-1970 was used. Maximum coarse aggregate size used is 20 mm.

5.4 Water: Portable water was used in the experimental work for both mixing and curing purposes.

6. Mix Proportion

Mix design is done based on IS 10262:1982. The concreting was done according to IS 516: 1959. The concrete samples were cured for 28 days in portable water and the specimens with SRA were cured for 28 days at room temperature in shade. The M20 grade concrete is designed and the material required per cubic meter of concrete with cement 383Kg/m^3 & water 192 Lit/ m^3 is shown in Table.

S.No	TYPE	Mix Proportion	
		RIVER SAND (kg/m3)	SEA SHELL (kg/m3)
1	RS 100	546	0
2	SS 100	0	546
3	SS 80	109.2	436.8
4	SS 60	218.4	327.6
5	SS 40	327.6	218.4
6	SS 20	436.8	109.2

7. TESTING

7.1 Compaction Factor Test: The compacting factor test is designed primarily for use in the laboratory but it can also be used in the field. From this we can check the workability also.

7.2 Compression Test: It is done in the machine capacity of 2000 KN. The axis of the specimen is carefully aligned with the centre of the spherically seated plate. The spherically seated block is brought to bear on the specimen and the load is applied without shock and continuously at a rate approximately 140 kg/cm^2/min until failure of the specimen. The maximum load applied to the specimen until failure is recorded. Then based on the load value the compression strength of the concrete specimen is calculated as follows

F_c = P/A, where, P is load & A is area

7.3 Splitting Tensile Strength: It is done in the machine capacity of 500 KN. The cylinder is placed in such a way that the load is applied on the circumference area of the cylinder. The cylinder is then subjected to loading and then the strength is calculated as follows

Fsplit = 2 P/πDL, where L=length of the cylinder,P=load, D= diameter of cylinder

SPECIMEN TESTING

8. RESULTS AND DISCUSSION

COMPACTION FACTOR:

S.NO	TYPE	COMPACTION FACTOR
1	RS 100	0.901
2	SS 100	0.913
3	SS 80	0.908
4	SS 60	0.895
5	SS 40	0.892
6	SS 20	0.888

MECHANICAL PROPERTIES:

S.No	TYPE	F_c (N/mm²) 14 DAYS	F_c (N/mm²) 28 DAYS	F_{split} (N/mm²)
1	RS 100	27.33	31.44	4.28
2	SS 20	24.25	33.93	4.61
3	SS 40	27.77	35.26	4.32
4	SS 60	29.34	36.04	4.21
5	SS 80	32.76	37.44	4.58
6	SS 100	37.55	42.58	4.92
7	SST 100	27.59	36.55	3.99

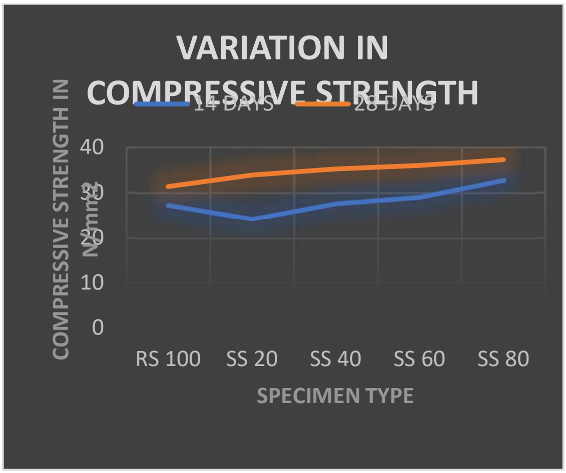
COMPRESSIVE STRENGTH

The compressive strength obtained for SS100 variant is 37.55N/mm^2 & 42.58N/mm^2 in 14 & 28 days respectively, which is more than controlled concrete.

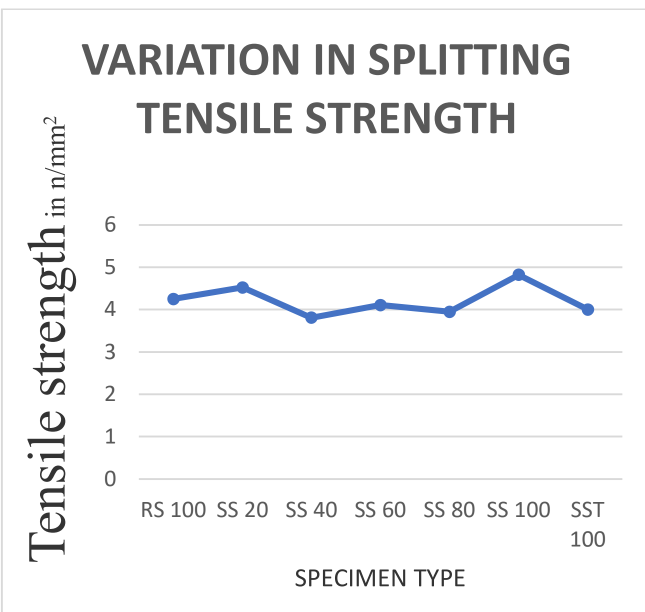
SPLITTING TENSILE STRENGTH

The splitting tensile strength obtained for SS100 variant is 4.92 N/mm^2 which is more than controlled concrete.

VARIATION IN COMPRESSIVE STRENGTH



VARIATION IN SPLITTING TENSILE STRENGTH



9. CONCLUSION

From the experimental results the workability and mechanical strength properties of concrete made with sea shell were similar to those of control concrete. it is also found that compressive strength, splitting tensile strength is better than conventional concrete.

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