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Experimental Study On Partial Replacement Of Crushed Cockle Shell (CCS) As Fine Aggregate In The Strength Of Concrete

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1.0 Abstract:-
The fine aggregate is one of the widely used materials in the manufacture of concrete. The fine aggregate (river sand) is very scarce in India and also in the globe. There are many substitute materials for the replacement of fine aggregate such as fly ash, quarry dust etc. Similarly Crushed cockle shell (CCS) extracted from the sea shore is used as a partial replacement of fine aggregate in the strength of concrete. The CCS is dried, crushed, sieved and partially replaced with 0%, 5%, 10%, 20% and 25% in M15, M20 and M25 grade of concrete. The cubes, cylinders and prisms were casted and it is been cured for 14 and 28 days. The cured specimens were tested for compressive strength, Split tensile and flexural strength of concrete and it is found that at 20% replacement of CCS in fine aggregate results in the maximum compressive strength, split tensile and flexural strength of concrete.

Keywords:- Concrete, Fine aggregate, Crushed Cockle shell (CCS), Compressive strength, Split tensile, Flexural strength.

2.0 Introduction:
Concrete is an excellent material for construction. The materials used for the manufacture of concrete are not only costly but also attracts various environmental impacts. The global consumption of natural sand is very high due to extensive use of concrete. In general, the demand of natural sand is quite high, which results in deliverance of good quality natural sand. The extraction of river sand from river beds causes many problems such as loosening of water retaining sand strata, soil erosion, loss of vegetation on the river banks etc. Fine aggregate and coarse aggregate constitute about 75% of total volume of concrete. Since fine aggregate is very scarce, many researchers made research by replacing the fine aggregate with waste materials and found the strength of concrete. This paper deals with the partial replacement of fine aggregate with cockle shell waste which is obtained from the fisheries industry. Effort towards preserving natural fine aggregate for the future and reducing the cockle shell waste has initiated this possible move to replace it with fine aggregate on 0%, 5%, 10%, 15%, 20%, 25%. It is to be studied the compressive strength, split tensile strength and flexural strength of concrete by partial replacement of CCS with fine aggregate on different percentages. K.Muthusamy and N.A Sabri made a study on "A Potential Partial Coarse Aggregate Replacement in Concrete". It is studied that the cockle shell waste was partially replaced with coarse aggregate in concrete at 0%, 5%, 10%, 15%, 20%, 25% and 30% and it is moulded and cured for 28 days. It is studied that the workability and the compressive strength of concrete is maximum at 20% replacement of CCS in coarse aggregate which further reduces on additional percentage replacement.

3.0 MATERIAL INVESTIGATION
An experimental investigation has been carried out to determine the properties of cement, fine aggregate, coarse aggregate and crushed cockle shell (CCS).
Ordinary Portland cement can be classified as being either 33 grade, 43 grade, or 53 grade. Ordinary Portland cement 53 grade conforming to IS 12269 is used. The specific gravity test for cement by Le-Chatlier flask and kerosene is done and it is confirmed to be 3.121. An investigation is done on confirming the specific gravity of fine aggregate and fineness modulus of fine aggregate used. It is confirmed that the specific gravity of fine aggregate is 2.5 and the fineness modulus of fine aggregate is Zone III of IS: 383:1970. The fine aggregate is taken in the river bed near Chennai. An investigation is done on confirming the specific gravity of fine aggregate and fineness modulus of crushed cockle shell (CCS) used. It is confirmed that the specific gravity of fine aggregate is 2.66 and the fineness modulus of fine aggregate is Zone III. The cockle shell is collected from kovalam sea shore, Chennai. It is studied from the above properties that the cockle shell waste can be partially replaced with fine aggregate because the specific gravity and fineness modulus is same as of fine aggregate. The specific gravity of CCS is shown in Fig.3.1 and the fineness modulus of CCS is shown in Fig.3.2

Fig.3.1. Specific gravity test of CCS

Fig.3.2.Fineness modulus test of CCS

4.0 EXPERIMENTAL INVESTIGATION

The main objective of this experimental investigation is to study the compressive strength, split tensile strength and flexural strength of the concrete with partial replacement of fine aggregate (river sand) with crushed cockle shell (CCS).

The cockle shell is extracted from the sea shore and it is washed and dried as shown in fig.4.1. The cockle shell is crushed using impact testing machine in order to reduce the particle size and it is sieved as shown in fig.4.2. The CCS used for the partial replacement of fine aggregate should be of size less than 4.75mm as shown in fig.4.3.

Fig.4.1. Cockle shell

Fig.4.2 Sieve analysis of CCS

Fig.4.3. Crushed Cockle Shell (CCS)

The grades concrete is prepared and placed in the mould (Cube and cylinder) of size 150mm x 150mm x 150mm and 150mm x 300mm. A layer of oil or grease is applied on the walls of the mould. The concrete is placed in three layers and compacted using a tamping rod of 25 blows. The concrete is allowed to set for 24 hours. Then concrete cubes are removed from the mould and the specimen are placed for curing of 3days, 7days, 28days and 56days as shown in Fig.4.4. After stipulated days, test the specimens for Compressive strength and split tensile test by applying the compressive load and tensile load as shown in fig 4.5 and 4.6. To determine the flexural strength of concrete, the concrete is prepared and place it in the mould of size 100mm x 100mm x 500mm and repeat the same procedure. The load is applied at the third point of the span of 400mm as shown in Fig.4.7.

Fig.4.4. Casted and Curing Specimens.

Fig.4.5. Compressive test specimen

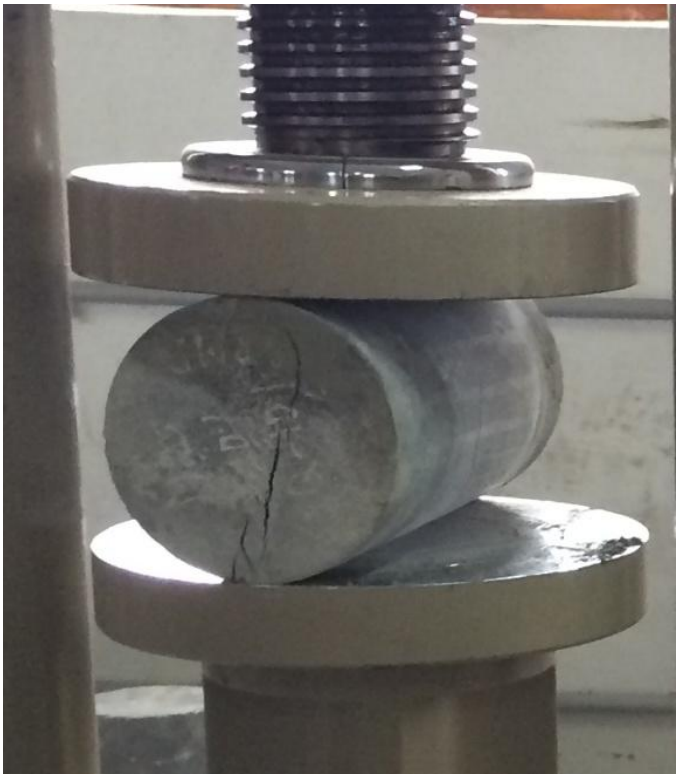

Fig.4.6.Tensile Test specimen

Fig.4.7.Flexural Test specimen

5.0 RESULTS AND DISCUSSIONS:

The values of Compressive strength of concrete, Split tensile strength and flexural strength of concrete for M15, M20 and M25 grades at 0%, 5%, 10%, 15%, 20% and 25% are given in Table1.

Table:1: Values of Compressive strength, Split tensile and Flexural strength of concrete for 14 days and 28 days

Grade of Concrete	% Replacement	Compressive Strength N/mm^2		Split Tensile Strength N/mm^2		Flexural Strength N/mm^2	
		14 days	28 days	14 days	28 days	14 days	28 days
M15	0	14.32	19.48	1.32	2.42	1.32	2.42
	5	13.48	18.95	1.414	2.55	1.414	2.55
	10	13.89	19.2	1.52	2.67	1.52	2.67
	15	14	20.56	1.59	2.81	2.67	3.312
	20	15.38	22.45	2.54	3.2	3.48	4.76
	25	14.4	21.85	3.12	2.48	2.91	3.47
M20	0	17.54	23.47	1.37	1.57	1.37	1.57
	5	16.64	22.9	1.51	1.98	1.51	1.98
	10	17.94	23.49	1.98	2.38	1.98	2.38
	15	18.42	24.6	2.48	2.971	2.48	3.74
	20	19.87	28.77	3.12	2.84	3.16	5.13
	25	19.3	25.32	2.98	3.42	2.98	4.61
M25	0	19.45	26.8	1.48	1.95	1.48	1.95
	5	18.94	25.7	1.73	2.122	1.73	2.122
	10	20.32	25.79	1.86	2.27	1.86	2.27
	15	22.45	27.64	2.15	2.86	2.87	3.96
	20	24	29.33	3.45	2.84	3.42	5.98
	25	23.67	28.47	3.1	3.75	3.1	4.75

The values of the 14th day and 28th day compressive strength of concrete cubes for M15, M20 and M25 grades with respect to the percentage replacement of fine Aggregate with CCS are shown in Fig.5.1, Fig, 5.2 Fig.5.3 respectively.

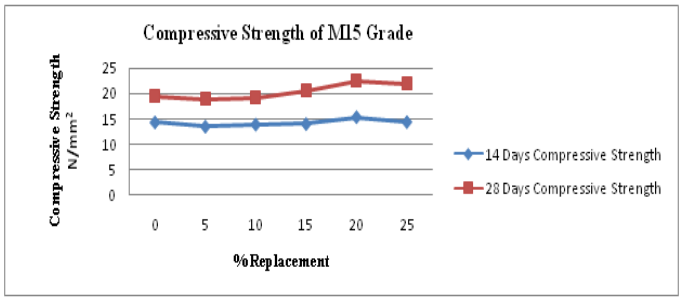

Fig.5.1. Compressive strength of M15 grade of concrete with respect to the partial replacement of CCS

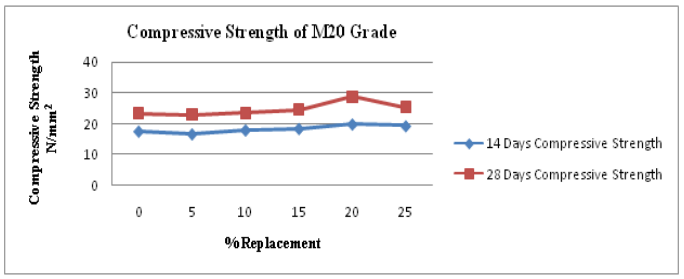

Fig5.2. Compressive strength of M20 grade of concrete with respect to the partial replacement of CCS

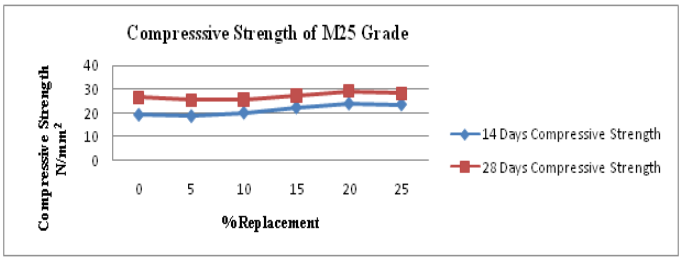

Fig5.3. Compressive strength of M25 grade of concrete with respect to the partial replacement of CCS

The values of the 14th day and 28th day split tensile strength of concrete cylinders for M15, M20 and M25 grades with respect to the percentage replacement of fine Aggregate with CCS are shown in Fig.5.4, Fig.5.5, Fig.5.6 respectively.

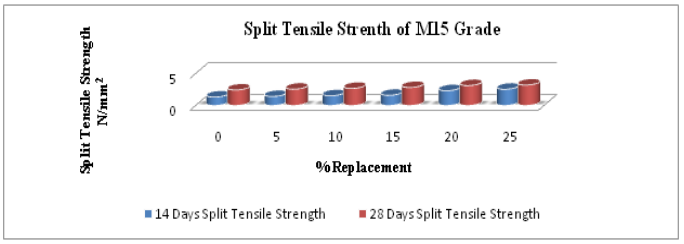

Fig.5.4. Split tensile strength of M15 grade of concrete with respect to the partial replacement of CCS

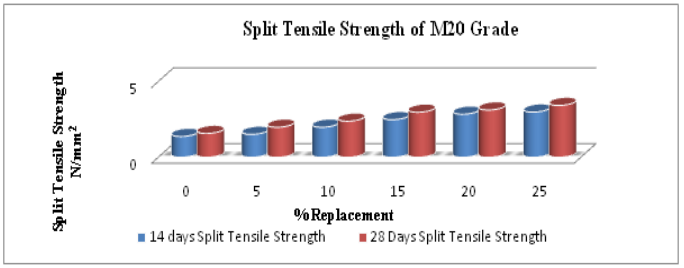

Fig.5.5. Split tensile strength of M20 grade of concrete with respect to the partial replacement of CCS

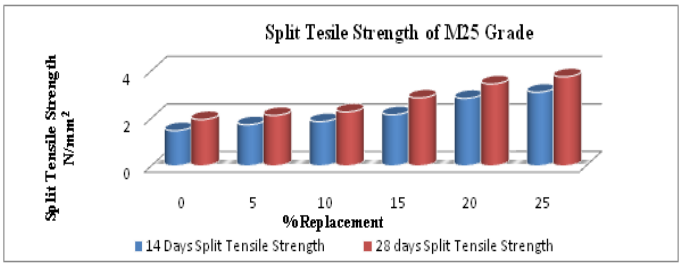

Fig.5.6. Split tensile strength of M25 grade of concrete with respect to the partial replacement of CCS

The values of the 14th day and 28th day flexural strength of concrete prisms for M15, M20 and M25 grades with respect to the percentage replacement of fine Aggregate with CCS are shown in Fig.5.7, Fig.5.8, Fig.5.9 respectively.

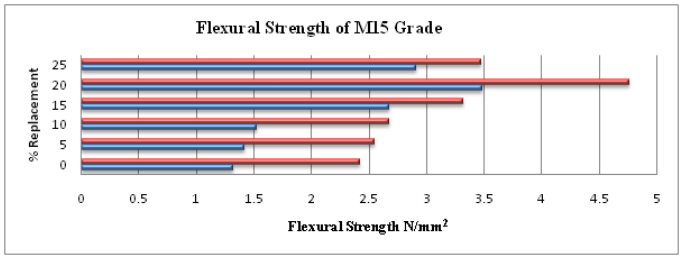

Fig.5.7. Flexural strength of M15 grade of concrete with respect to the partial replacement of CCS

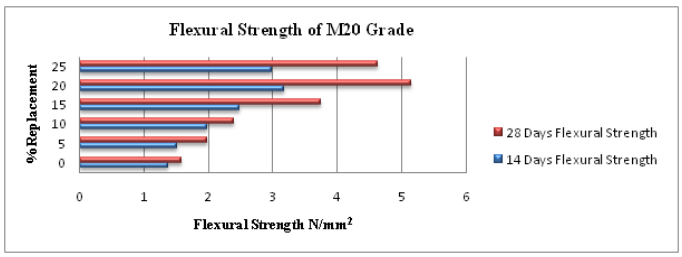

Fig.5.8. Flexural strength of M20 grade of concrete with respect to the partial replacement of CCS

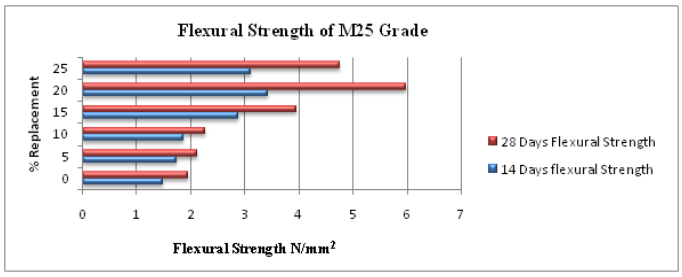

Fig.5.9. Flexural strength of M25 grade of concrete with respect to the partial replacement of CCS

6.0 CONCLUSION:-

From the study it is found that replacement of crushed cockle shell (CCS) by 20% as a fine aggregate in concrete shows higher compressive strength, Split tensile strength and flexural strength than that of normal concrete with 100% fine aggregate. In order to make use of these building materials more efficiently and make people aware of its benefits, an organized technique is required to promote them. It is very important that people are aware of the benefits of using the substitutes for construction materials. According to various researchers the cockle shell waste is effective as a replacement in fine and coarse aggregate.

7.0 REFERENCES:

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