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EXPERIMENTAL STUDY OF THE CONCRETE REPLACING FINE AND COARSE AGGREGATE WITH CERAMICS AND E-WASTE

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Abstract - In present-day productions, the dissipation of ceramic materials is expanding day by day in the form of tiles, sanitary fittings, electrical insulators etc. But a lot of ceramic materials changes into wastage during processing, transporting and fixing due to its brittle nature. By replacing the fine and coarse aggregate by e-waste and ceramic waste in M25 grade concrete to achieve the durability, workability, sustainability, and also it will maintain the environment. In this abstraction, an effort has been made to treasure wastes as an achievable counterfeit decorous crushed stone coarse aggregate. Data were carried out to determine the compressive, splitting tensile and flexural strength of concrete with ceramic waste coarse aggregate and to compare them with those of conventional concrete made with crushed stone coarse aggregate. The properties of the aggregate were also compared test result indicate that the workability of ceramic & e-waste coarse aggregate concrete is good and the strength characteristics are comparable to those of the conventional concrete. An experimental study is made by preparing specimens by utilising ceramic & e- waste particles as coarse aggregates in concrete with a percentage replacement. The findings revealed that using waste ceramic tile lead to enhancing the properties of concrete.

Keywords: Ceramic Waste, Compressive Strength, Eco-Friendly, Aggregate, Concrete, Flexural strength

I. Introduction

To develop a cost effective as well as ecofriendly structure to fulfill the need of the human being. The concrete has three basic components which are cement, fine and coarse aggregate. In these components only cement is manufactured and both fine and coarse aggregate has been obtained naturally. This has brought up with a great destruction to the environment. To solve these problems use of waste materials such as e-waste and ceramic waste etc if are dumped in open ground is hazardous to environment. These materials have also benefits that these materials are easily available and economical. In this research these wastes are used in forms as fine and Coarse aggregates simultaneously. Ceramic tiles give more durablitity and also produce high strength in the entire test (2). It gives only best result only in 10% replacement more the conventional concrete (3). Researches have shown crushed stone dust can be used to replace the natural sand in concrete. Recycle aggregates like ceramic industry on heating conditions so ceramic can be used as coarse aggregates. Present study has been done to evaluate the suitability of such waste materials in concrete production.

II. Physical Properties of the Material Used

A. Sieve Analysis

A suitable quantity of dry sand of known weight of about 1000gm is taken and set of sieve are arranged according to their sizes with largest apparatus's sieve at the top, and smallest operative sieve at bottom. The set of sieve is kept in a mechanical shaker and 10min of shaking is done. The amount of sand retained on each sieve is weighted. On the basis of sample taken and the weight of the sand retained on each sieve, the % of the total weigh of the sand passing through each sieve can be calculated.

TABLE I. Sieve Analysis on Fine Aggregate

S. No	Is Sieve Size	Weight Retained In Grams	% Retained	Cum % Retained	Finer %
1	4.75mm	0.098	0.0049	0.0049	99.99
2	2.36mm	0.214	0.0107	0.0154	99.98
3	1.18mm	0.452	0.0226	0.038	99.96
4	600 micron	0.693	0.0346	0.0726	99.92
5	300 micron	0.475	0.0237	0.0964	99.90
6	150 micron	0.042	0.0021	0.0985	99.90
7	90 micron	0.008	0.0004	0.0989	99.90
8	Pan	0.006	0.0003	0.0992	99.90

Fineness modulus of fine aggregate = w_1/w_2 *100 = 1.986 / 2000 * 100 = 99.3%

Fineness modulus of fine aggregate is 99.3%

TABLE – II. Sieve Analysis on Coarse Aggregate

S.No	Is Sieve Size	Weight Retained (G)	Cumulative Weight	Cumulative Weightret	Cumulative % Passing

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			Retained	ained %	
1	20mm	0.572	28.6	28.6	71.40
2	16mm	0.990	49.51	78.6	21.89
3	13.6mm	0.376	18.8	96.91	3.09
4	12.5mm	0.024	1.2	98.12	1.88
5	4.75mm	0.023	1.151	99.27	0.73
6	2.36mm	0	0	0	0
7	PAN	0	0	0	0

Fineness modulus = cumulative weight retained % / 100

= W2 / W1 * 100

= 1.985 / 2 * 100 = 99.25%

Fineness modulus of coarse aggregate = 99.25%

B. Specific Gravity Test

To determine the particles size of given aggregates being obtained from the source with help of sieve shaker apparatus, the specific gravity of soil grains (G) using the following (4,5) equation $G = \frac{(W_2 - W_1)}{(W_2 - W_1) - (W_3 - W_4)}$ (1)

Where,

W_1 = Empty weight of pycnometer.

W_2 = Weight of pycnometer + oven dry soil

W_3 = Weight of pycnometer + oven dry soil+ water

W_4 = Weight of pycnometer + water

Table – 3 : Specific Gravity of the Material Used

Cement	3.15
Fine Aggregate	2.60
Coarse ggregate	2.70
Ceramics rushed Tile	2.30
Ceramics Powder	1.8
E-wast	1.67

Cement - 3.15

Fine Aggregate - 2.60

Coarse Aggregate - 2.70

Ceramics Crushed Tile - 2.30

Ceramics Powder - 1.8

E-wast - 1.67

C. Water Absorption Test

Water absorption test is conducted to determine the absorption capacity of the materials used (1) To determine the water absorption of the specimen

$$\text{Water absorption} = \frac{W_2 - W_1}{W_1} * 100 \quad (2)$$

TABLE IV. Water absorption test of the Material Used

Fine Aggregate	Coarse Aggregate	Ceramics Crushed Tile	Ceramics Powder	E-waste
2.27	0.5	12.5	23.6	0

III. Mix Design

Cubes and beams are made to calculate the compressive strength and flexural strength using M25 concrete grade

Cube mould of area 150x150 mm2. It is named as C1 as 25% and C2 as 50%. Beam mould of size 170x150mm2. It is named as B1 as 25% and B2 as 50% Table V shows the mix proportions of the concrete with the standard procedure (1)

TABLE – V. Mix Proportion of the Concrete

	Cement	Fine Aggregate	Coarse Aggrgate
Ratio	1	1.39	1.85
Kg.m^3	531.42	737.88	975.25

IV. Mechanical Properties of the Concrete

A. Compressive strength on concrete

The mould after filling with coarse was placed on the vibrating table. After 14 days was over the cube was taken out. Then the cube was taken out. Then the cube specimen was placed the compression testing machine. The load was gradually applied and the value at which the maximum failure occurs was noted. Similarly the remaining cubes were tested. At the end of 28 days of the remaining cube specimens was taken and compressive strength was found out.

TABLE VI. Compression test on Cube for 7 days

Description		Trail1	Trail2	Avg
Load	Cube 1 for 25%	580	600	590
Compression strength (N/mm^2)	7 days	25.77	26.66	26.22
Load	Cube 1 for 50%	450	457.8	457.8
Compression strength (N/mm^2)	7 days	20	20.67	20.35

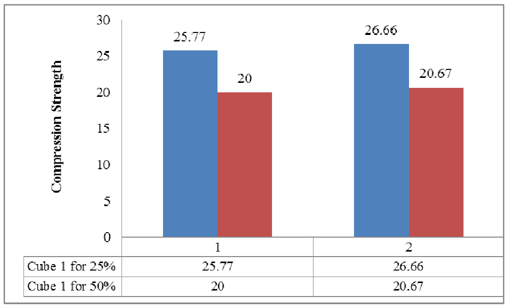

Fig.1 Compression test on Cube for 7 days

TABLE VII. Compression test on Cube for 28 days

Description		Trail1	Trail2	Avg
Load	Cube 1 for 25%	700	720	710
Compression strength (N/mm^2)	28 days	31.5	32.27	31.55
Load	Cube 1 for 50%	600	580	590
Compression strength (N/mm^2)	28 days	26.67	25.77	26.22

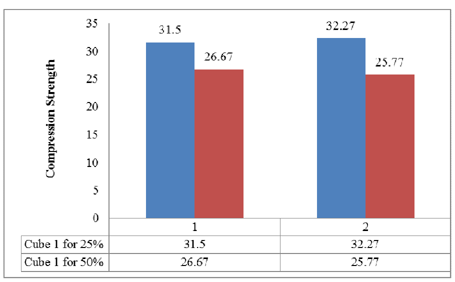

Fig.2 Compression test on Cube for 28 days

B. Flexural strength on concrete

The cylindrical specimen is placed horizontally between the loading surfaces of a compression testing machine. Narrow packing strips of suitable material such as plywood is used to reduce the high compression stresses. The load is applied without shock and increasing continuously at a rate of the specimen. The load is increased till the specimen fails and the continuous load applied to the specimen during the test is recorded, the figure 3 shows the split tensile testing machine for the concrete cylinder.

TABLE VIII. Tensile strength test on Beam for 7 days

Description		Trail1	Trail2	Avg
Load	Beam 1 for 25%	220	235	228
Tensile strength (N/mm^2)	7 days	1.9	2	2.02
Load	Beam 1 for 50%	590	570	580
Tensile strength (N/mm^2)	7 days	5.2	5.1	5.2

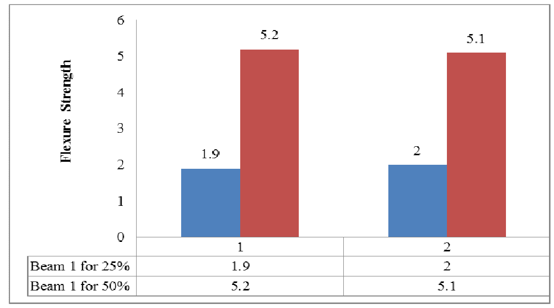

Fig.3 Tensile strength test on Beam for 7 days

TABLE IX. Tensile strength test on Beam for 28 days

Description		Trail1	Trail2	Avg
Load	Beam 1 for 50%	175	190	183
Tensile strength (N/mm^2))	28 days	1.5	1.7	1.6
Load	Beam 1 for 50%	440	475	458
Tensile strength (N/mm^2))	28 days	3.9	4.1	4.2

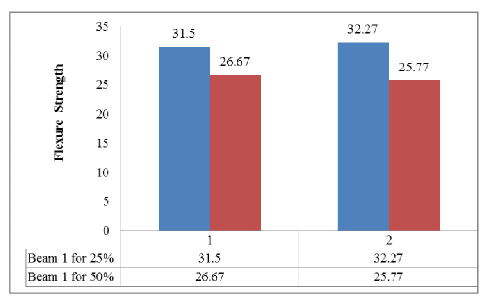

Fig.4 Tensile strength test on Beam for 28 days

V. Conclusion

The use of ceramics and E-waste in concrete is possible to improve its mechanical properties and can be one of the economical ways for their disposal in environment friendly manner. It is used as a water repellent breathable, light weight, flexible, acid and alkali resistant to freezing and thawing, earthquake resistant, crack resistant, good compatibility with exterior insulation system; safety advantage. The graph shows that the waste can be used as partial replacement which is cost effective and provides more strength and durability than the coarse aggregate.

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