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EXPERIMENTAL STUDY ON PARTIAL REPLACEMENT OF WASTE CEREMIC TILES USED AS AN ALTERNATIVE COARSE AGGREGATE IN CONCRETE

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Abstract-The global consumption of natural aggregates is high, due to the day-by-day innovations and development in construction field. At the same time production of solid waste from the demolitions and manufacturing units are also very high. This study presents the experimental behavior of concrete with partial replacement of waste ceramic tiles used as an alternative coarse aggregate and it is compared with controlled cubes. Aggregates are replaced by waste ceramic tiles for various percentages 25%, 30%, 35% and the strength is checked. It is expected that the strength of cubes for replacements will not have any adverse effect on strength and there might be slight improvement in strength. This replacement would prove to some environment benefits and would be an economical or a cost effective technique concreting for the future. The compressive and split tensile strength tests are conducted to evaluate the strength.

Keywords— Waste ceramic tiles, Compressive strength, split tensile strength, coarse aggregate, cost.

I. INTRODUCTION

A large amount of natural aggregates such as sand and water are being consumed in concrete production. To minimize these, experts have focused on the use of waste materials as potential alternatives in the construction industry. In-fact, especially in concrete construction use of waste materials such as plastic, slag, fly ash, etc., is one of the main aim of researchers to achieve sustainable construction impart about 70% - 75% of volume, where ceramic tiles can be used as an coarse aggregate. It can be a new scientific sobriety in the field of sustainable concrete. If we use waste and broken tiles as coarse aggregates in concrete manufacturing. Ceramic tiles can be used as coarse aggregate since they are angular in nature and can be used in similar size of coarse aggregate. This replacement has a huge saving of energy and also has an environmental benefits. Besides, it will also have influence on decreasing the concrete costs. Thus aggregates are replaced by waste ceramic tiles for various percentages 25%, 30% and 35% to increase quality, strength and to minimize cost.

II.OBJECTIVE AND SCOPE OF WORK

Adding of waste ceramic tiles to concrete as a supplement actually decreases the construction cost and more or less maintains the concrete properties. In addition to that, when these waste materials are processed properly, have shown to be effective as construction materials and readily meet the design specifications. The aim of this project is to utilize solid waste materials in the best way in construction field without any hazardous effect on strength.

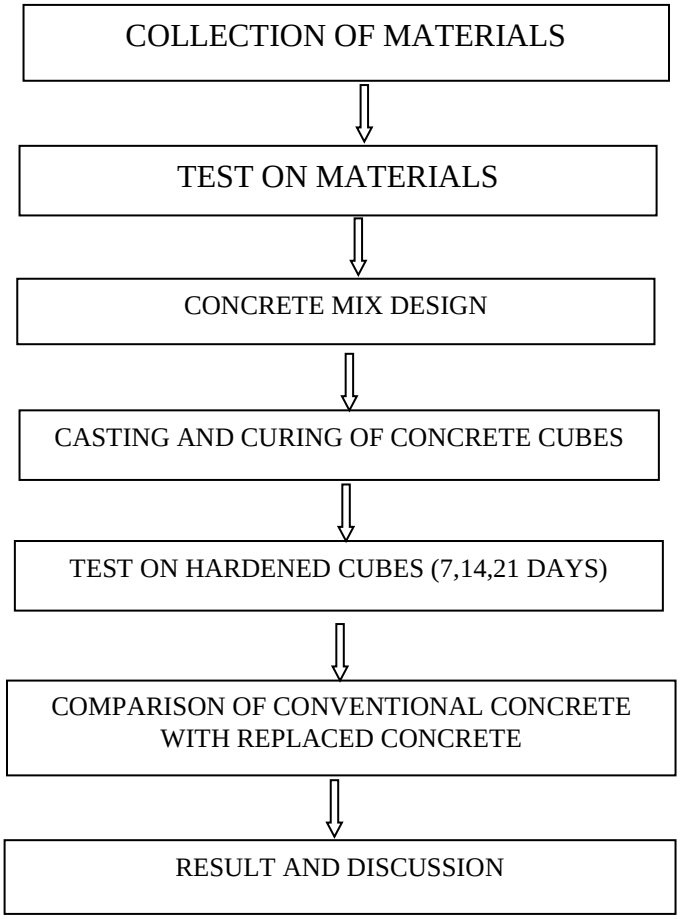
2.1 OBJECTIVES:

1. To study the partial replacement of coarse aggregate with waste ceramic tiles
2. To compare the strength of replaced concrete with the conventional concrete.

2.2 SCOPE OF WORK:

The scope of this study aims at manufacturing a concrete of high strength by using waste ceramic tiles as coarse aggregates. Replacement was done in 25%, 30%, 35% and this would lead to considerable environmental benefits and would be economical. We can also determine the mix ratio for coarse aggregate for obtaining optimum strength.

III.METHODOLOGY



IV.EXPERIMENTAL MATERIALS

Ceramic tiles aggregate are hard having considerable value of specific gravity, light weight than normal aggregate and rough surface on one side and smooth surface on other side. Replacement of ceramic aggregate is not only cost effective but also environment-friendly. The waste ceramic tiles are broken into pieces in nominal size (20mm as per IS 383-1970) and mixed with concrete as partial replacement of coarse aggregate. The usage of waste tiles would lead to reduce the environmental pollution. The properties of ceramic tiles are well within the range of the values of concrete making aggregate since, there are no harmful chemical on tiles

Table 1.Physical properties of ceramic aggregate

S.NO	PROPERTIES	WASTE CERAMIC TILES
1	Particle shape	Irregular

2	Size	10mm-20mm
3	Specific gravity	1.63
4	Texture	Smooth and glassy

Other materials such as cement, sand are also tested. Cement is a binding material and it is tested for its physical properties such as specific gravity (3.15 average specific gravity), consistency (0.29), and initial and final setting time. The fine aggregate should pass through a IS sieve of size 4.75mm and the sand should be free from impurities. The fine aggregates are also tested for its physical properties such as Specific gravity – 2.66 and average water absorption – 0.7. The coarse aggregates showed the following test results on their physical properties, Specific gravity – 2.73, which must pass through 20mm sieve and retained in 12mm sieve will be used for casting all specimens.

V.CONCRETE MIX DESIGN

The concrete mix has been designed based on Indian standard code IS: 456-2000. The cement content must be adequate for mild exposure condition as per IS:456-2000. Degree of workability should be around 0.09 and degree of quality control must be good for concrete.

Table 2. Mix proportion

WATER(ml)	CEMENT(Kg)	FINE AGGREGATE(Kg)	COARSE AGGREGATE(Kg)
718	1.66	2.49	4.98
0.45	1	1.5	3

Table 3. Concrete mixtures with different proportion of waste ceramic tiles (Kg/m^3)

MIX MATERIALS	CONTROL CUBE (Kg)	25% REPLACEMENT (Kg)	30% REPLACEMENT (Kg)	35% REPLACEMENT (Kg)
CEMENT	1.66	1.66	1.66	1.66
FINE AGGREGATE	2.5	2.5	2.5	2.5
COARSE AGGREGATE	5	3.75	3.5	3.25
CERAMIC TILES	0	1.25	1.5	1.75

VI. RESULT AND CONCLUSION

6.1. Compressive strength: There are nine cube specimens 150*150*150mm size (as per the IS 10086 - 1982) is casted by M20 grade and mix design for compressive strength test. The concrete is immersed in water for 28 days. The specimens are taken on 7 days from the day of curing, 14 days and 28 days.

Table 4. Comparison of compressive strength results

	CONTROL CUBE (N/mm^2)	25% REPLACEMENT OF C.A (N/mm^2)	30% REPLACEMENT OF C.A (N/mm^2)	35% REPLACEMENT OF C.A (N/mm^2)
7^{TH} DAY	16.13	17.5	23.2	20.23
14^{TH} DAT	22.01	23.8	31.5	27.3
28^{TH} DAY	25.9	26.88	35.47	31.67

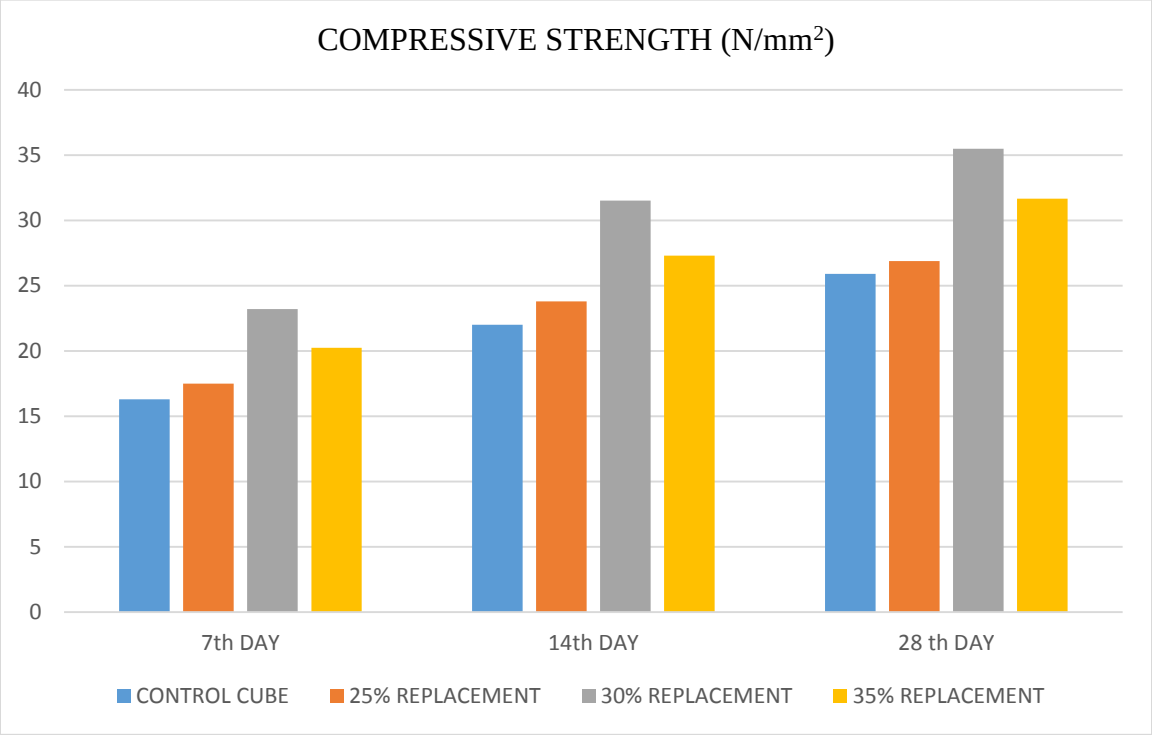


Figure 1. Compressive strength of replaced waste ceramic tiles

After 28 days curing when compared with conventional concrete, replacement of 25% ceramic tiles gives compressive strength of 26.88N/mm^2 and which is 0.98N/mm^2 greater than conventional concrete. And replacement of 30% tiles give strength of 35.47N/mm^2 and which is greater than the ordinary concrete by 9.57N/mm . Further increase in percentage will result in decrease in value so the optimum percentage is 30%

6.2. Split tensile strength:

Nine cylinder moulds of size 150 mm diameter and 300 mm height are casted with various replacement percentages of sand and cement with waste ceramic tiles and de-moulded 3 hours from the casting. The specimens were immersed into water for curing up to 7, 14, 28 days.

Table 5. Split tensile strength test results

	CONTROL CYLINDER (N/mm^2)	25% REPLACEMENT OF C.A (N/mm^2)	30% REPLACEMENT OF C.A (N/mm^2)	35% REPLACEMENT OF C.A (N/mm^2)
7^{TH} DAY	1.677	1.82	2.41	2.10
14^{TH} DAY	2.29	2.48	3.28	2.84
28^{TH} DAY	2.69	2.8	3.69	3.3

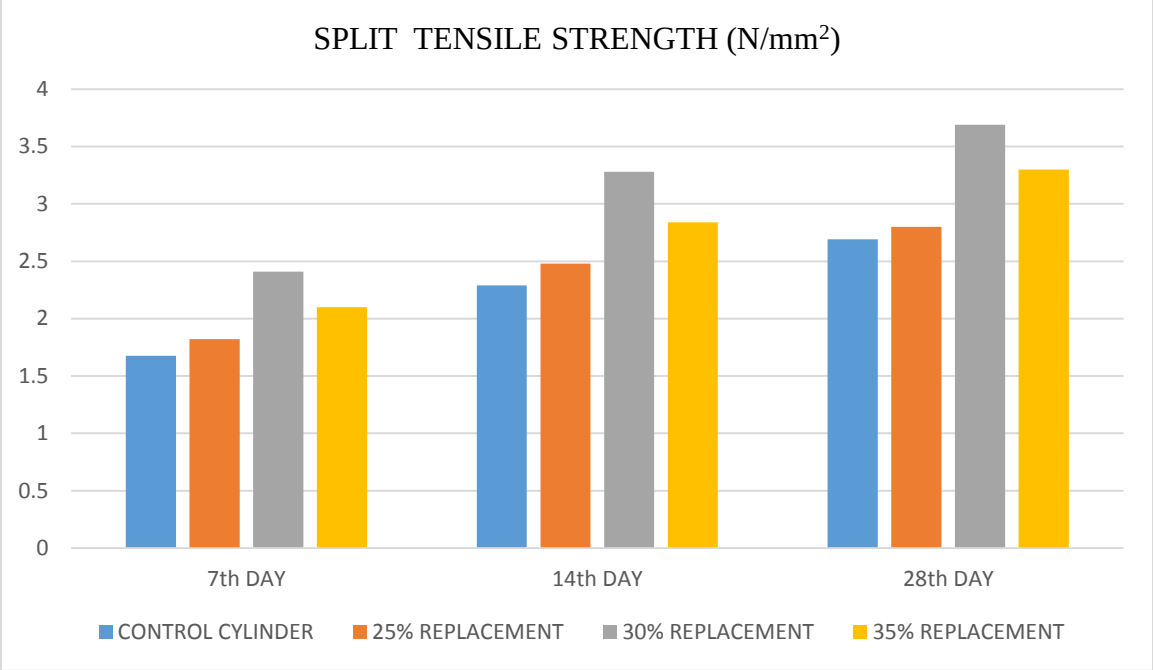


Figure 2. Split tensile strength of replaced waste ceramic tiles

After 28days curing when we compared replaced concrete to conventional concrete the addition of 25% of ceramic tiles gives flexural strength of $2.8N/mm^2$.And addition of 30%tiles gives $3.69N/mm^2$ which is greater than conventional concrete by $1N/mm^{2.}$ Further addition of replacement will lead to decrement.

VII. CONCLUSION

From the experimental study and discussion, it is concluded that addition of waste ceramic tiles are economical, easily available and advisable from the environmental point of view, so that it results in reduction of construction based. For natural aggregates mining is required but tiles can ignore this process.

1. From the test result it shown, only the partial replacement is successful rather than complete replacement of ceramic tiles as coarse aggregate. Beyond a certain percentage of replacement strength starts to decrease.

2. Compressive strength increases at 30% replacement of ceramic tiles and decreases on increasing the proportion. So 30%of replacement is an optimum percentage.
3. The compressive strength of ordinary concrete is 25.9 N/mm^2 and the increased strength in replaced concrete at 30% was 35.47N/mm^2 at 28 days of curing.
4. Split tensile strength was found to be comparatively more than the control concrete. The strength of ordinary cylinder is 2.69N/mm^2 and the increased strength in replacement concrete at 30% was 3.69N/mm^2 at 28 days curing
5. There is no doubt that the use of waste ceramic tiles is cost free materials which represents substantial savings for civil construction and also reduces waste produced from construction or demolishing works.

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