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Reuse of Crushed Ceramic Tiles as a Coarse Aggregate in Concrete

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Abstract: ***The reuse of ceramic waste as a substitute for coarse aggregate in concrete has been investigated in this paper. The ceramic wastes are of three types, namely Tiles, Clay bricks were used. This study focuses on use of ceramic tile aggregate in concrete production. Ceramic tile obtained from manufacturing industries, construction and demolition sites that affects to environmental pollution. The utilization of crushed tile as a coarse aggregate in concrete are also have a positive effect on the economy. So the reuses of ceramic tile aggregate are major effect on the environment. In the present study, Ceramic tile waste are used in concrete for natural coarse aggregate with 0%, 5%,10%, 20% of the substitution and M20 grade concrete were used. Some of laboratory tests are performed. The concrete moulds were casted and tested for Compressive Strength and after a curing period of 3, 7 & 28 days. During the period of curing properties of concrete are achieved more effectively.***
Keywords: Ceramic Tile Aggregate (CTA), Normal aggregate, Water-cement ratio, Compressive strength, Specific gravity, Sieve analysis, crushed strength, Water absorption…

I. INTRODUCTION

The industrial development causes serious problems all over the world such as depletion of natural aggregates and creates amount of waste material from construction and demolition activities. One of the ways to reduce this problem is to utilize the waste. A large quantity of wastages produced annually in all countries, in particular construction and demolition waste contributes the highest percentage of wastes worldwide. About 75% of the waste likes broken brick, tiles, aggregate, plastic etc. Furthermore, ceramic materials contribute the highest percentage of wastes within the construction wastes worldwide about 75%. Furthermore, ceramic materials contribute the highest percentage of wastes within the construction and demolition wastes about 54%. Ceramic waste is durable, hard and highly resistant to Biological, Chemical and Physical degradation forces. Ceramic tile aggregate are hard having considered value of specific gravity, rough surface on one side and smooth on other side, are lighter in weight than normal stone aggregates. Using ceramic tiles as aggregate in concrete not only will be cost effective but also will be good from environmental point of view. For proper utilization of waste material are achieved.

The following section gives a brief background and some of the important pertinent studies that were carried out to the considered work, Studied on the utilization of waste materials in concrete production which is helpful to the goal of sustainable construction. This study intends to use of Ceramic tile aggregate having 20mm maximum size of coarse aggregate. Ordinary Portland cement (OPC) 45 grade and sand were used. Compressive tests were carried out, but beyond that, strength started decreasing gradually with the increase in the proportion of tile aggregate in concrete. Studied by replacing crushed tile as a coarse aggregate in concrete with partial replacement of 0%, 5%, 10% of natural aggregate.

II. MATERIALS

1) *Cement:* Cement is a fine powder, which when mixed with water and allowed to set and harden, is masses of solid matter together to produce a mechanically strong material. The most commonly used cement is ordinary Portland cement of 43 grade confirming to IS:12269. The tests conducted on cement are Standard Consistency, Specific Gravity and Setting time..
2) *Coarse Aggregates:* The fractions above 4.75mm are termed as coarse aggregate. The crushed aggregates used were 20mm nominal maximum size and are tested as per Indian standard sand results are within the permissible limit.
3) *Ceramic tile Aggregate:* CTA are crushed uniformly to about 20mm size manually using hammer and sieved through 20mm IS: Sieve. The various test were conducted on the ceramic tiles are specific gravity, water absorption and impact test.
4) *Water:* Water available from the local sources conforming to the requirements of water for concreting and curing as per IS: 456-2000.

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SAMPLE OF MIXTURE



III. METHODOLOGY

A. *Material Used In Tests*

1) *Cement 43 Grade:* Ordinary Portland cement with a specific gravity of 3.15 is used in experimentation. Normal consistency of the cement is found to be 26%. Initial and final setting time are 95 and 240 respectively. Bulk density of 1440 kg/m3
2) *Coarse Aggregate:* 20 nun nominal size coarse aggregate having a specific gravity of 2.68 is used. The impact value and water absorption of coarse aggregates is 21.23% and 0.4 %. Density of 1650 kg/m3
3) *Ceramic Tile:* Ceramic tiles are collected from the renovated construction in Guntur. After collecting they were crushed into small particles in the laboratory. Tiles powder is separated from the crushed tiles and partially larger tiles are again crushed and were taken to the experimentation. The impact value of' crushed tiles 20%. Bulk density is 2750 kg/m3

Table 1 Comparison between Production of Tiles Aggregate and Normal Aggregate.

Sr. No	Properties	Normal Aggregate	Tile Aggregate
1	Shape	Angular	Flaky
2	Texture	Rough	All sides rough except top
3	Water absorption	0.5%	14%
4	Impact value	15%	20%
5	Specific gravity	2.69%	2.61
6	Crushing strength	10%	21%

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IV. RESULT AND ANALYSIS

A. *Compressive Strength*

Compressive strength test was performed on concrete cube specimen of size 15cm*15cm*15cm to check strength by obtaining the 7 days 14 days and 28 days compressive strength. The compressive strength of cube is calculated by dividing the maximum compressive force by the cross-sectional area of the cube specimen. Following table shows compressive test of sample of M 20 grade concrete at 7, 14, 28 days.

Table 2 Compressive test of M 20 grade concrete cube at $7^{th,}$ 14^{th} and 28^{th} day

TILE AGGREGATE REPLACED WITH NORMAL AGGREGATE	COMPRESSIVE STRENGTH ACHIVED At 7^{th} Day N/mm^2	COMPRESSIVE STRENGTH ACHIVED At 14^{th} Day N/mm^2	COMPRESSIVE STRENGTH ACHIVED At 28^{th} Day N/mm^2
0%	20.72	24.06	29.03
5%	20.10	23.18	28.21
10%	18.48	21.38	27.95
20%	18.24	21.79	27.04

V. CONCLUSIONS

From this study it is concluded that,

A. Ceramic tile aggregate is an appreciated and appropriate concrete material for substitution into concrete composition based on its properties.

B. Mechanical properties of ceramic aggregate are similar to the natural aggregate and its behavior is similar but not same. Water absorption, crushing value and impact value, are higher than natural coarse aggregate and lower by specific gravity i.e. 2.61 g/cm^3

C. It is possible in M 20 grade concrete to substitute 20% of normal 20 mm aggregates with ceramic tile aggregates without compromising its required compressive strength.

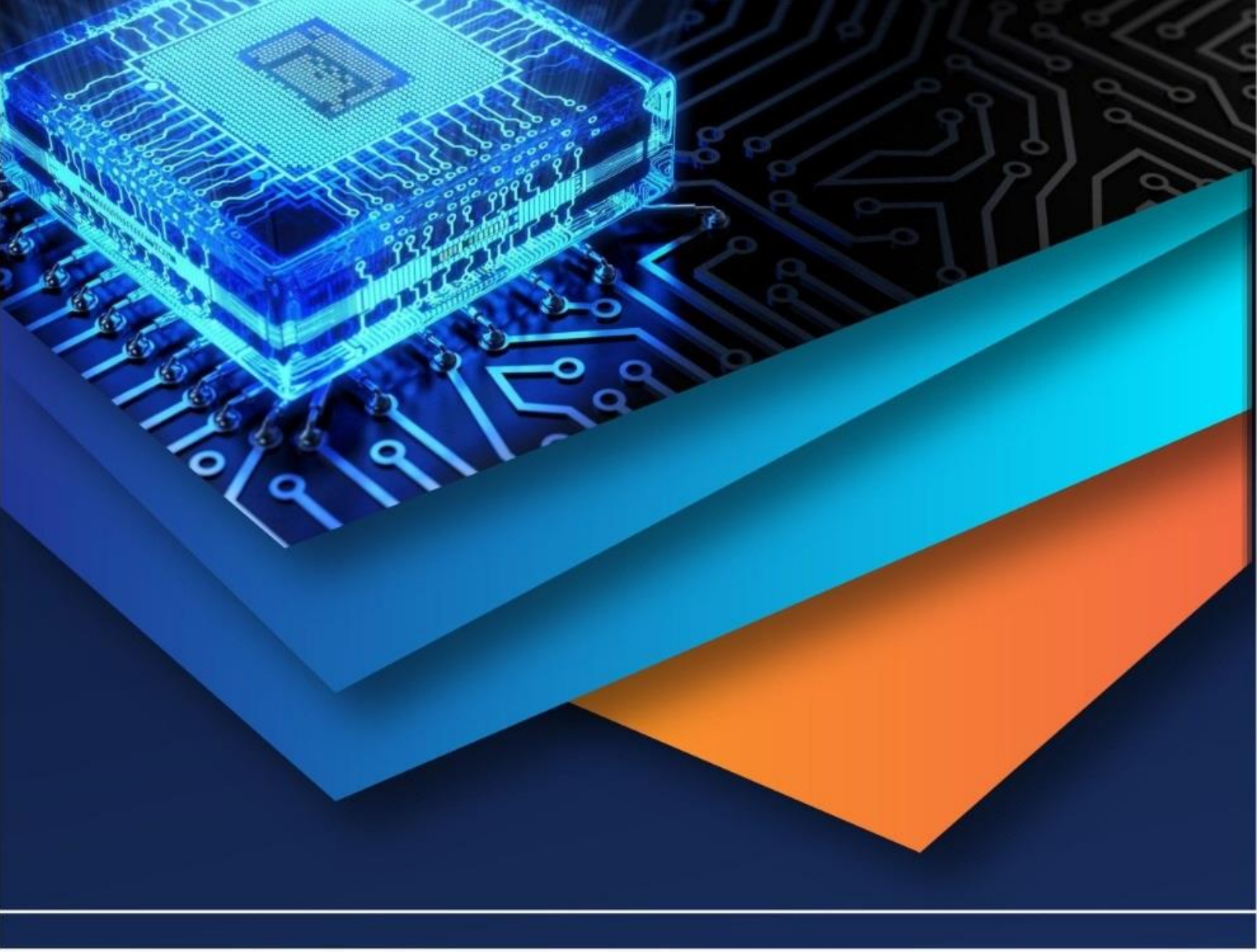
D. For all concrete mixes (M 20, M25, M30) compression strength of concrete decreases with increase in the proportion of replacement of natural aggregates with tile aggregates which is due to low specific gravity higher porosity of tile aggregates as compare to natural aggregates

E. For use of some admixture to improve strength such as silica fume, super plasticize

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