Experimental Analysis on Concrete by Partial Replacement of Fine Aggregate with Powdered

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Abstract: Concrete is the most flexible substance in building construction. River Sand is infrequently available now and other substitute materials are being endeavour. Ceramic tiles are widely used in building industry in which about 25% becomes squander. This examination deals about change the sand incompletely with 10%, 20%, 30% and 40% of unused powdered ceramic tile in concrete. The test outcome for M30 grade concrete with water cement ratio of 0.4 and incomplete replacement by 30% shows a growth of 13% and 15% respectively in compressive and flexural strength. As 40% replacement of sand with ceramic tile, the compression and flexural strength are at par with normal concrete. The result leads to the successful performance of ceramic tile waste thus by decreasing the disposal and environmental issues**.**

Keywords: Ceramic Tile, Fine Aggregate, Compressive Strength, Flexural Strength

1. INTRODUCTION

Concrete plays a vital role in the construction industry. This paper is related with the lack of natural assets and its react on the environment. Always India is graded third in the manufacturing of ceramic tiles. 25% of ceramic tile is wasted during the manufacturing, transportation, and usage. Ceramic tile squander is found as an effective substitute and additional material in concrete as a renewal for fine aggregate which is acquire expensive nowadays. Crushed tiles were calm from the solid waste of ceramic production unit and from demolished building. The waste tiles were crushed into small pieces by manually and by using crusher. The required size of crushed tile aggregate was separated to use them as partial replacement to the natural coarse aggregate. The tile waste which is lesser than 4.75 mm size was neglected. The crushed tile aggregate passing through 16.5mm sieve and retained on 12mm sieve are used. Crushed tiles were partially replaced in place of coarse aggregate by the percentages of 10%, 20% and 30%, 40% and 50% individually and along with replacement of fine aggregate with granite powder also

2. Material:

2.1 Cement:

In this research 53grade of ordinary Portland cement (OPC) is used and is confirming to IS 12269:2013. The Specific gravity of cement is 3.15. The Initial setting time of the opc cement for is 30mts and final time is 9hr 45mts.

2.2 Fine Aggregate:

Here the fine grade aggregate was used from local available sources and it is falls under Zone III and confirming to IS 383:1970 .Fine aggregate which passes through 4.75mm size IS sieve and it's having a specific gravity of 2.67.

Property	Value	Specification
Source	**Kurnool**	**IS383:1970**
Zone	III	
Specific Gravity	**2.67**	
W.A.	**0.5-1%**	
Colour	**Yellow Brown**	

Properties of Fine Aggregate

2.3 Coarse Aggregate:

In this research 20mm to 10mm size of coarse aggregate material is used and its obtained from local available sources and is confirming IS 383:1970.Both the diameter of aggregate were sieved in separately and the portion of coarse aggregate was

in the ratio of 60:40 and its Specific gravity and water absorption of used aggregated are 2.74 & 0.5% and 2.74 & 1.0% respectively.

Property	Value	Specification
Source	Kurnool (AP)	IS:383:1970
Specific gravity	2.74	
W.A	0.5-1%	
Colour	Greyish Black	

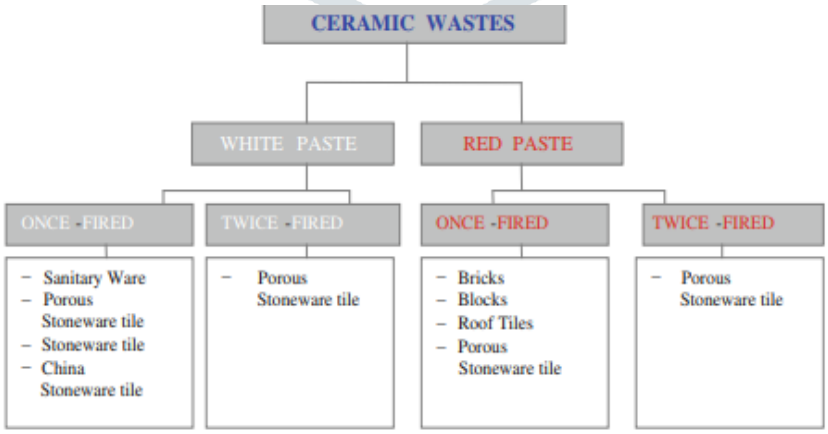
Properties of Coarse Aggregate

2.4 Ceramic Tile Waste:

It is an important construction material used in all type of construction works. The Waste material of Ceramic tiles and powdered is used and its bulk density and water absorption of the material are 2.35gm/cc and 0.45%.

Considering of various oxides of the Ceramic waste contain 12% high Sio_2 (Silicon dioxide). Compare to flyash which is useful for replacement as fine aggregate not only Silicon dioxide the other oxide like potassium oxide and sodium oxide (K_2o,Na_2o) of 4.50% and 1% of the chemical composition of ceramic tile also higher in compare to flyash.

Ceramic Tile Waste



Flow Chart of Ceramic Waste

2.5 Super plasticizers:

In this research the super plasticizers is used as "Conmix SP1030". It is a brown liquid instantly dispersible in water and it is used for reducing of water, permeability and increasing in strength. CONMIX SP1030 is basically high range water reducing super

plasticizer admixture. It considerably reduces the amount of water required to achieve the same workability of concrete at a nominal dosage. It develops the strength and durability of concrete. It produces extremely workable and flowing concrete without loss of strength and with reduced w/c ratio. It can be used in mass concrete work, precast concrete work, structural R.C.C construction, congested reinforcement areas, heavy industrial construction etc.

Super plasticizers of Conmix SP 1030

Data	Value
Appearance	Brown Liquid
Sp. Density	1.2 at room temperature
Chloride Content	0
pH	7-8

Technical data for Conmix SP 1030

2.6 Water:

Clean drinking water was used for mixing and curing and water cement ratio assumed as 0.4.

3. Preparation of Specimens:

In this research M30 grade concrete Mix design is used and the mix proportions are 1:2.57:3.17 as per IS 10262-2009 code

3.1 Mixing of Concrete:

Miller is used for the mixing of concrete.

3.2 Moulds:

The cubes are casted with size 150x150x150mm and beams are casted with size 100x100x500mm.

3.3 Curing:

After 24hours of casting the cubes and beam moulds are demoulded and placed in the curing pond at room temperature for 7 and 28 days.

4. Tests on Specimens:

4.1 Compressive strength of concrete:

Compressive strength is the capacity of material or structure to transfer the loads on its surface without any crack or deflection. Compressive strength test was carried out on 150x150x150mm size cubes. The below fig shows Compressive strength test on concrete and the formula is:

Compressive Strength = Load / Cross-sectional Area

=P/A

Where: P =Total load applied in N

A= Area of the cube

CTM

4.2 Flexural test:

The below fig shows the prism loaded in the universal testing machine. Flexural test was carried out on 100x100x100mm size beams and formula is:

Ultimate Flexural Strength $=PL/bd^2$

Where,

P = Total load applied on the beam (N)

L = Supported length (cm)

b = Width of specimen (cm)

d = Depth of beam (cm)

UTM

5. M-20 CONCRETE MIX DESIGN:

The various proportions for different percentage replacement of ceramic tile waste are given below table

Mix Proportioning Per Cubic Meter of Concrete

MIX NAME	CW in % kg/m^3	C kg/m^3	FA kg/m^3	CA20 kg/m^3	CA12 kg/m^3	W kg/m^3	SP kg/m^3
CTW-0	0	355	896	456	684	142	7.1
CTW-1	10	355	886	456	684	142	7.1
CTW-2	20	355	876	456	684	142	7.1
CTW-3	30	355	866	456	684	142	7.1
CTW-4	40	355	856	456	684	142	7.1

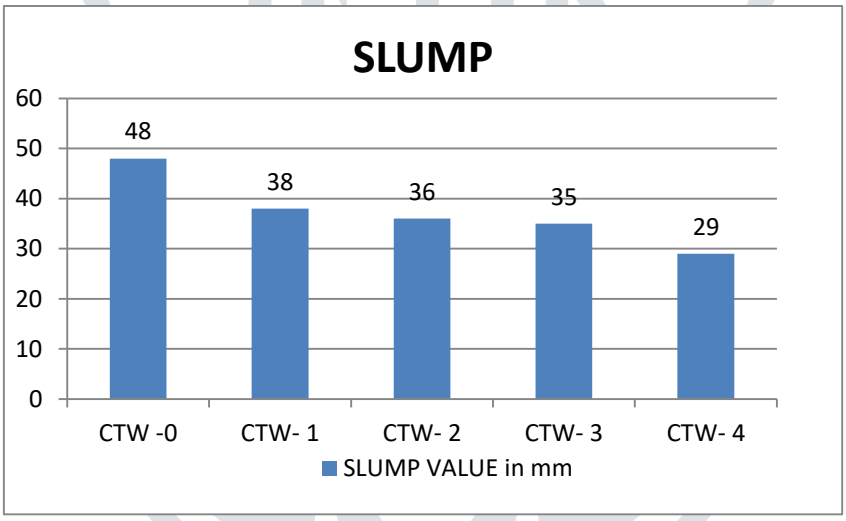
Note: CW- Ceramic tile waste, C- Cement, FA- Fine Aggregate, CA20- 20mm Coarse Aggregate mix, CA12- 12mm Coarse Aggregate mix, W- Water in kg, SP- Super Plasticizer.

6. RESULTS AND DISCUSSIONS:

6.1 Workability:

Workability of concrete made using ceramic tile waste was determined at different replacement level. The results are shown in the below table and represent by graphical form also. It is evident form that Workability of concrete made using ceramic waste reduces with rise in replacement level.

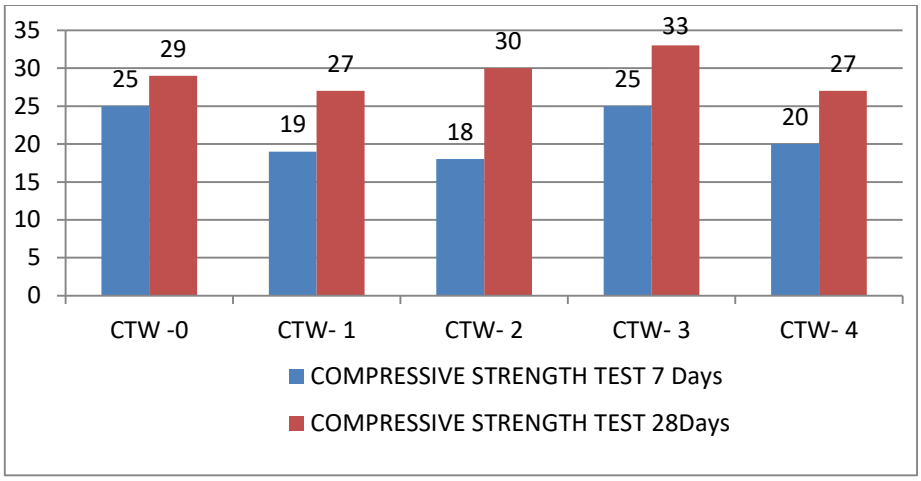
MIX NAME	CTW in %	SLUMP VALUE in mm
CTW -0	0	48
CTW- 1	10	38
CTW- 2	20	36
CTW- 3	30	35
CTW- 4	40	29



6.2Compressive Strength:

The compressive strength of concrete made using 10% replacement level reduced when compared to conventional concrete. There was an increase in compressive strength from 10% replacement up to 30% and then decreases to 40% replacement level. These compressive strength tests will be conducted by after 7days and 28 days curing. The results will be shown in given below table and we represent by graphical form also. It is inferred that 30% of replacement is the optimal replacement.

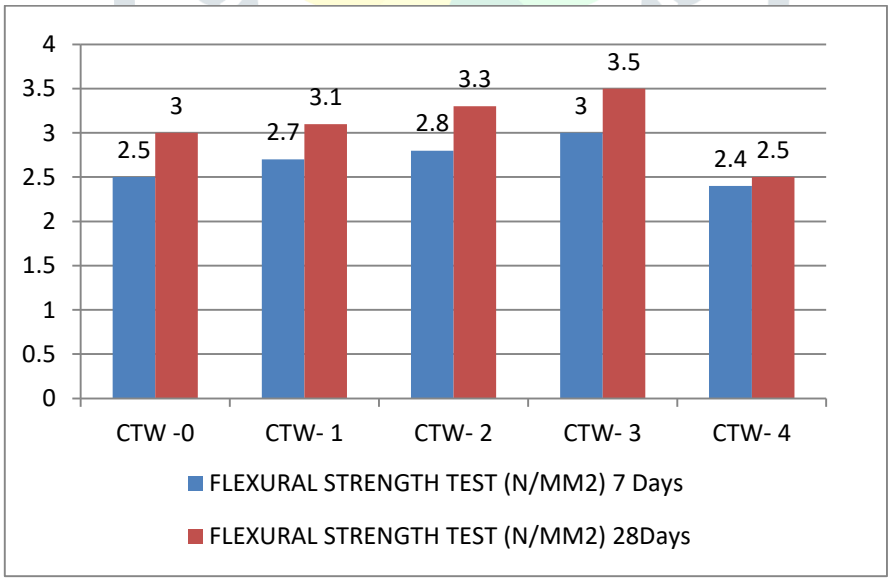
DESIGN MIX	COMPRESSIVE STRENGTH TEST (N/MM^2)	
	7 Days	**28Days**
CTW -0	25	29
CTW- 1	19	27
CTW- 2	18	30
CTW- 3	25	33
CTW- 4	20	27



6.3 Flexural Test:

The flexural strength results of beam specimens for 7 and 28 days are in below tabular and we represent by graphical form. For 7 days test, the strength rises from gradually 10% to 30% and reduces at 40% of powdered ceramic tile waste replacement. For 28 days strength increases from 10% to 30% and reduced shortly for 40% powdered waste replacement.

DESIGN MIX	FLEXURAL STRENGTH TEST (N/MM^2)	
	7 Days	28Days
CTW -0	2.5	3.0
CTW- 1	2.7	3.1
CTW- 2	2.8	3.3
CTW- 3	3.0	3.5
CTW- 4	2.4	2.5



For 7 days test, the flexural strength increases gradually from 10% to 30% and reduces at 40% of powdered ceramic tile waste replacement. For 28 days the flexural strength increases gradually from 10% to 30% and reduced abruptly for 40% powdered ceramic tile waste replacement

7.CONCLUSION :

- Using waste powdered ceramic tiles as partial replacement of fine aggregate, workability decreased with increase in replacement level.
- The optimal replacement level of fine aggregate with powdered ceramic waste was found to be 30%.
- The 40% replacement was a marginally less compressive strength with that of conventional concrete.
- The compressive strength increased up to 13.43% and the flexural strength increased up to 15.55% at 30% replacement level compared to conventional concrete. Powdered ceramic waste can be effectively used in concrete by reducing the environmental problem

8.REFERENCES

- [1] Indian Standard Code for "Plain and Reinforced Concrete – Code of Practice" – IS 456:2000
- [2] Indian Standard Code for "Concrete Mix Proportioning – Guidelines" – IS 10262: 2009
- [3] Indian Standard Code for "Ordinary Portland Cement, 53 Grade-Specification"-IS 12269: 2013
- [4] Indian Standard Code for "Specification For Coarse and Fine Aggregates from Natural Sources for Concrete"- IS 383: 1970
- [5] Indian Standard Code for " Concrete Admixtures- Specifications"- IS 9103: 1999 Indian Standard Code for " Methods of Tests for Soils" –IS 2720: 1985 (PART V)
- [6] Indian Standard Code for " Methods of Tests for Soils" –IS 2720: 1985 (PART V)
- [7] Indian Standard Code for " Methods of Test for Aggregates for Concrete" IS 2386: 1963 (PART III)
- [8] Hitesh Kumar Mandavi, Vikas Srivastava,V. C.Agarwal, "Durability of Concrete with Ceramic Waste as Fine Aggregate Replacement" Vol 4, Issue 12, Dec 2015.
- [9] Hemanth Kumar Ch, Ananda Ramakrishna K, et.al, "Effect of Waste Ceramic Tiles in Partial Replacement of Coarse and Fine Aggregate of Concrete ".vol 2, Issue 6, (June 2015).
- [10] MdDaniyal, Shakeel Ahmad "Application of Waste Ceramic Tile Aggregates in Concrete ", Vol 4, Issue 12, Dec 2015
- [11] Ponnapati. manogna, M.Sri Lakshmi "Tile Powder as Partial Replacement of Cement in Concrete", IRJET, Vol2, Issue4, July 2015
- [12] Jay Patel, dr. B.K. Shah, Prof P.J. Patel "Ceramic Powder in Concrete by Partial Replacement of cement- A Literature Analysis" Impact Factor 1.393, ISSN: 2320-5083, Volume 2, Issue 3, April 2014.
- [13] Francis Kenna, Paul Archbold., ET, .al "Ceramic Waste Sludge as a Partial Cement Replacement" Aug 2014.
- [14] A.Mohd Mustafa Al Bakri, M.N. Norazian, H. Kamarudin, et.al, "The Potential of Recycled Ceramic Waste as Coarse Aggregates for Concrete" Jan 2008.
- [15] IS 2386-1963, Method of Test for Aggregate for Concrete, Bureau of Indian Standards, New Delhi.
- [16] IS 516-1959, Method of Tests for Strength of Concrete, Bureau of Indian Standards, New Delhi.
- [17] IS 383-1970, Specifications for Coarse and Fine Aggregate from Natural Source of concrete", Bureau of Indian Standards New Delhi.
- [18] IS 12269-1987, Specifications for 53 Grade Ordinary Portland Cement", Bureau of Indian Standards, New Delhi.

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