Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 10, October - 2017

Experimental Study on Partial Replacement Fine Aggregate by Broken Tiles in Concrete

Utkarsh Singh Chandel
Post Graduate Student, Department of Civil Engineering,
Laxmi Narain College of Technology,
Bhopal,MP,India

Rambharosh
Assistant Professor, Department of Civil Engineering
Laxmi Narain College of technology,
Bhopal,MP,India

Abstract— **The industrial or constructional waste containing many inorganic and toxic substances beyond the acceptable limit cause impact to living life. To overcome these issues these waste can be recycled and reused for any useful purpose. Ceramic industry waste and demolished ceramic waste obtained in various forms like ceramic powder, broken tiles etc. which is disposed to landfill create pollution at a larger rate. [1] In this project work ceramic waste tiles are collected and broken into pieces for partial replacement with fine aggregate. These replacements will reduce the cost of the project at greater percentage because aggregates are more costly in cement for concrete production.[3] Sand is the major component of concrete which is naturally available and hence limited in availability to reduce the burden on environment use of alternative is required. This paper presents the results of an experimental study on the partial replacement of the natural sand with the waste ceramic tiles in a range of 10% to 40% in the interval of 10 % in M20 and M25 grade of concrete. Effect of various percentages of replacements towards compressive strength, split tensile & flexural strength of concrete. The results show that tiles aggregate can effectively be used in concrete as partial replacement of sand with improve strength and durability.**

Keywords—(Fine Aggregate, Ceramic Waste Tiles, Compressive Strength, flexural strength, Split Tensile strength)

I. INTRODUCTION

Concrete is a most versatile construction material because of its property to withstand the hazardous situations, with satisfactory durability and strength. Due to over utilization of the concrete materials it creates the sense of fear and furthermore, the generation at bigger rate is hazardous to the earth. On opposite side, the waste presented to our condition is an effect to biological cycle, among all mechanical waste, is the significant quantity of waste which will influence the earth. Cement and aggregate, which are the most basic constituents used in concrete production, are the basic materials required for the construction industry. This certainly incited a constant and extending enthusiasm of natural materials used for their production. Parallel to the necessity for the utilization of the natural resources builds up a creating stress for guaranteeing the earth and a need to spare natural resources, for such as aggregate, by using elective materials that are either reused or discarded as a waste. Most of the construction and demolition waste in our country are not recycle but end up in landfills occupying valuable land not to mention the cost incurred in land filling.[5] However, many of the construction industry in India produce construction waste that contributes largely to solid waste. In general, the solid waste material is a result of the construction waste material or residual results from the renovation of the building such as stone, wood, iron, cement and other waste materials. This research will focused on ceramic wastes obtained from the industry in India. Presently in the ceramic industry, the production goes as waste, which is not undergoing the recycle process yet. [6] Conventionally, the coarse aggregate used in concrete productions are gravel, crushed stone, granite, and limestone. Ceramics are regularly utilized as a part of the fabricate of the divider and floor tiles, and blocks and material tiles. Clean ceramics, as with all other ceramic items, are delivered from normal materials which by and large contain kaolin, china mud, feldspar, potassium, and quartz (F. Pacheco and S. Jalali, 2010). Ceramics industry joins the going with portions: ceramic deck and divider covers (ceramic floor and divider tiles, independently), ceramic sterile item, squares and material tiles, wilful materials, ceramics for inventive applications (encasings, et cetera.), and ceramic articles for family unit and lighting up purposes (flatware and trimmings). Development industry as the end client of all the ceramic materials is all around ready to take care of this natural issue which is somewhat its own. The utilization of waste items in concrete temperate as well as settles a portion of the transfer issues. Pounded ceramic aggregate can be utilized to deliver lightweight concrete, without influencing strength. The high consumption of raw materials by the construction sector results in achronic shortage of building materials and the associated environmental damage. [7] In the last decade, the construction industry has seen various researches conducted on the utilization of waste products in concrete in order to reduce the utilization of natural resources. [8].

II. MATERIALS USED

A. Ceramic Waste Tiles

Ceramic waste is accessible from vast ceramic industrial facilities, ceramic item producing units and from regular development exercises. Customary ceramics, for example, blocks, rooftop and floor tiles, other development materials, and specialized ceramics, for example, porcelain are normally very heterogeneous because of the wide compositional scope of the common muds utilized as crude materials. Around 300 kg of wastes from an Indian ceramic organization (RAK Ceramics Pvt. Ltd., Chennai) was smashed with an altering pole physically to make the ceramic aggregate. In this manner, by utilizing this framework to pound ceramic wastes is conceivable to acquire coarse aggregates, fine aggregates and ceramic powder that subsequent to sieving (IS 4.75 mm strainer) can be utilized without extra work and with insignificant cost suggestions. In India the Ceramic Tile Industry inexact worth is Rs.21,000 Crore and was accounted for, the Indian Ceramic Tiles industry developed by around 11% out of 2013-14 and anticipated that would achieve a size of Rs.301 billion by 2016. As in a present report of Global Ceramic Tiles Market of February 2016, the worldwide ceramic tiles market will develop at a CAGR (Compound Annual Growth Rate) of 9.59% amid the time of 2016-2020. [9] Comprehensively India is positioned third and represented more than 6% of aggregate worldwide generation. Indeed, even with an enormous development in the ceramic creation there is an improper utilization. Subsequently coming about to a gigantic wastage which is accounted for to be around 15%-30% yearly, created from the aggregate generation.

B. *Cement*

Ordinary Portland cement of 53 grade conforming to IS 8112-1989 was used. The initial setting time of cement is 30 minutes and the specific gravity of cement is 3.15.

Table 1 *Properties of Cement*

S. No	Material Properties	Cement Test Results
1.	Initial Setting Time	30 minutes
2.	Final Setting Time	600 minutes
3.	Standard Consistency Test	40%
4.	Specific Gravity	2.69
5.	Fineness	5%

C. *Fine aggregate*

Natural river sand which is locally available obtained from the Narmada river of Hoshangabad City is used as fine aggregates. Manufactured sand with fraction passing the 4.75mm sieve and retained on the 600micron sieve was used and fineness modulus of 4.04 with the specific gravity of 2.64 was used. The grading zone of aggregate was zone 2.

D. *Course aggregate*

Aggregates greater than 4.75mm are considered as aCoarse aggregate. Crusted granite coarse aggregate of 20mm downsize were used and the fineness modulus of 4.32 with a specific gravity of 2.63 was used.

E. *Water*

Water to be used for the Mixing and Curing purpose of cement concrete should be free of dirt and pollution. As per the IS: 456-2000 specifications.

F. *Fresh concrete*

The slump test was conducted on fresh concrete and the slump value is obtained for grade M20 and M25 by trial and mix error method.

III. MIX PROPORTIONS

In this research paper, M25, mix proportion is designed as per guidelines of Indian Standard recommended method IS 10262:2009. We used 53-grade cement; also zone 2 is taken into consideration from IS 383(1970) for fine aggregate. The coarse aggregate is selected passing through 20mm and retained on 10mm Sieve:

IV. RESULT AND DISCUSSION

A. *Slump Cone Test*

Table 3 *slump value*

S. No.	% of Replacement	Slump Value For M 20	Slump Value For M25
1.	0%	100	75
2.	10%	85	62
3.	20%	78	54
4.	30%	65	47
5.	40%	53	38

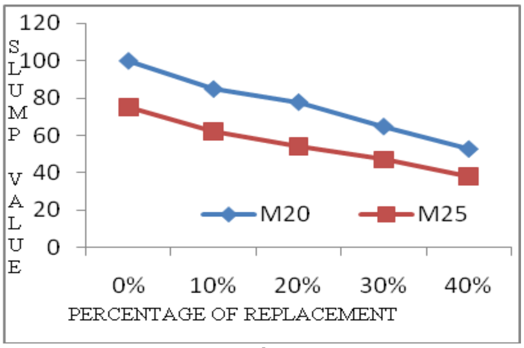

Figure 1. *Slump Cone Test*

B. *Compressive Strength Test*

Table 4 *Compressive Strength Values for M20 Grade*

S. No.	% of Replacement	Compressive Strength	Compressive Strength	Compressive Strength	Compressive Strength
		7 DAYS	*14 DAYS*	*28 DAYS*	*50 DAYS*
1	0%	17.47	21.43	26.70	31.63
2	10%	18.50	23.43	29.23	34.63
3	20%	20.50	24.60	30.77	35.43
4	30%	22.73	28.66	31.60	37.47
5	40%	24.40	30.12	33.60	40.63

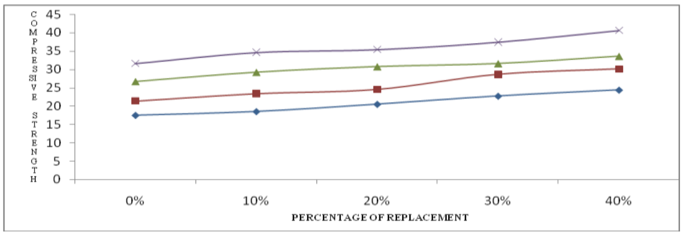

Figure 2. *Compressive Strength*

Concrete cubes of size 150mmx150mm were casted for 0%, 10%, 20%, 30%, 40%, 50% ceramic aggregate replacement. The compressive strength for M20 grade of concrete is tested for 7, 14, 28 and 50 days of curing and the results are tabulated and plotted below.

Table 2 Compressive Strength for M25 Grade

S. No.	% of Replacement	Compressive Strength	Compressive Strength	Compressive Strength	Compressive Strength
		7 DAYS	*14 DAYS*	*28 DAYS*	*50 DAYS*
1	0%	22.47	26.37	31.77	36.43
2	10%	23.37	28.60	34.17	39.37
3	20%	25.23	29.03	35.53	40.57
4	30%	27.77	35.30	38.20	42.67
5	40%	29.60	38.83	42.10	45.40

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 10, October - 2017

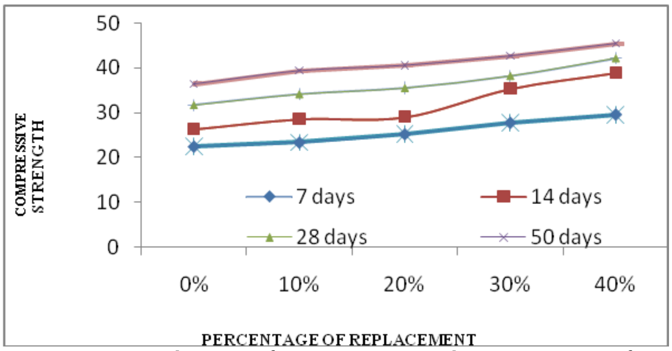

Figure 3. *Replacement of Ceramic Aggregate by Fine Aggregates for M25*

Concrete cubes of size 150mm x150mm x 150mm were casted for 0%, 10%, 20%, 30%, 40%, 50% ceramic aggregate replacement. The compressive strength for M25 grade of concrete is tested for 7, 14, 28 and 50 days of curing and the results are tabulated and plotted.

From both of the above graph i.e. M20 and M25, the compressive strength of concrete is increased gradually from 0% to 40% and attained a maximum value at a replacement of 40% ceramic aggregate in fine aggregate. However, the compressive strength of concrete for the partial replacement of Fine aggregate with a ceramic aggregate of 40% does not show major increment as compared to partial replacement of 30%. It may be observed that the graph is increasing gradually so it may increase or decrease on 50% replacement which can be studied further

C. Split Tensile Strength Test

Concrete cylinders of size 150mmx300mm were casted for 0%, 10%, 20%, 30%, 40% replacement of ceramic aggregate. The split tensile strength for M20 and M25 grade of concrete is tested for 28 days of curing and the results are tabulated and plotted below.

Table 5 *Tensile Strength values*

S. No	% of Replacement	Tensile Strength(M20)	Tensile Strength (M25)
		28 DAYS	***28 DAYS***
1	0%	3.09	4.58
2	10%	3.23	4.62
3	20%	3.96	4.72
4	30%	4.34	4.81
5	40%	4.41	5.19

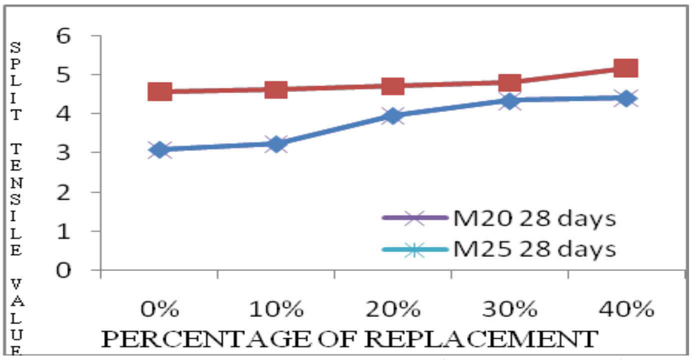

Figure 4.*Tensile Strength on Replacement of ceramic aggregate for M20& M25Grade*

From the above graph i.e. M20 grade of concrete, the Split tensile strength of concrete is increased gradually from 0% to 40% and attained a maximum value at a replacement of 40% ceramic aggregate in fine aggregate. From the above graph i.e. M25 grade of concrete, the split tensile strength of concrete is increased gradually from 0% to 30%.However, Split tensile strength of concrete for the partial replacement of Fine aggregate with a ceramic aggregate of 40% does not show major increment as compared to 30% and can be used by control mix.

D. Flexural strength test

Concrete beam of size 700mm x150mm x 150mm were casted for 0%, 10%, 20%, 30%, 40% replacement of ceramic aggregate. The Flexural strength for M20 & M25 grade of concrete is tested for 28 days of curing and the results are tabulated and plotted below.

Table 6 *Flexural Strength values*

S. No	% of Replacement	Flexure Strength(M20)	Flexure Strength (M25)
		28 DAYS	***28 DAYS***
1	0%	3.41	4.17
2	10%	3.67	4.20
3	20%	4.04	4.67
4	30%	4.14	4.76
5	40%	4.19	4.82

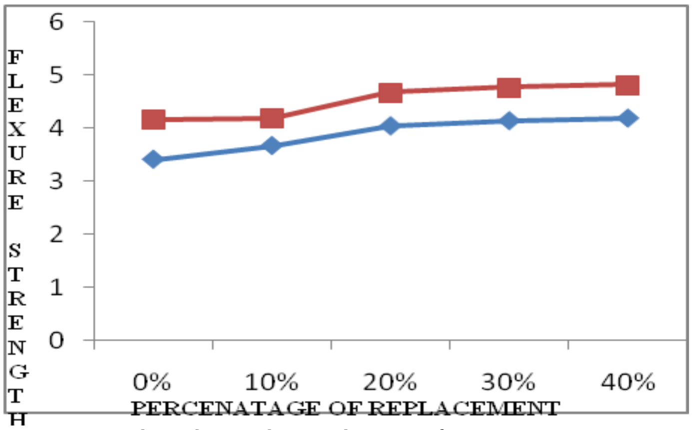

Figure 5. *Flexural Strength on Replacement of Ceramic Aggregate M20 & M25Grade*

CONCLUSIONS

Based on the analysis of experimental results and discussions there upon the following conclusions are made.

A. The Slump exhibits that the workability decrements with the extension in the rates of containing waste smashed tile aggregate with the percentage of 10% to 40%. All investigated containing waste pulverized tile aggregate mixes had stature slump regards and commendable workability at M20 & M25 grade of concrete.

B. Compressive quality outcomes speak to that concrete threw within M20 and M25 review of concrete at 7, 14, 28 and 50 days are enlargements, when the level of the waste squashed tile aggregate expansion from 0% to 40%.

C. We can see that the split tensile strength of concrete is extended when the level of the waste squashed tile aggregate have increments from 10%, 20%, 30% and 40% use as an

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 10, October - 2017

incomplete substitution in concrete at 28 days with M20 and M25 concrete review.

D. We can see that the flexure quality in M20 and M25 audit of concrete at 28 days, flexural quality are higher when level of usage of 10%, 20%, 30% and 40% of level of waste crushed tile aggregate with the supplanting of fine aggregate increases with the age of 28 days.

ACKNOWLEDGMENT

I am thankful to respected guide, Head of the Department of civil engineering and college LNCT Bhopal for their needful contribution in completion of my work. Also I'm thankful to my parents for their much needed support to complete this work.

REFERENCES

[1] Nutan A. Bhagat, P. P. Saklecha, R. S. Kedar, (2017) Strength Behavior of Concrete byPartial Replacement of Ceramic & Stone Waste with Coarse Aggregate and Copper Slag with Fine Aggregate, International Journal of Advance Research and Innovative Ideas in Education,ISSN (O)-2395-4396, 3(4), 869-883.

[2] N.Naveen Prasad, P.Hanitha , N.C.Anil,(2016) Partial Replacement of Coarse aggregate by Crushed Tiles and Fine aggregate by Granite Powder to improve the Concrete Properties, IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), e-ISSN: 2278-1684, 13(6), 168-176.

[3] J.Swathi, Ms.V.Gnanadevi, (2015) An Experimental Investigation on Concrete by Partial Replacement of Copper Slag for Fine Aggregate and Ceramic Waste with Coarse Aggregate, International Journal of Emerging Technology in Computer Science & Electronics,ISSN: 0976-1353, 13(4), 137-142.

[4] Hitesh Kumar Mandavi, Vikas Srivastava, V.C. Agarwal, (2015) Durability of Concrete with Ceramic Waste as Fine Aggregate Replacement, International Journal of Engineering and Technical Research (IJETR), ISSN: 2321-0869, 3(8),196-199.

[5] Mohd Nizam Bin Yusoff (2010), Waste Minimization by Recycling of Construction Waste.

[6] A.M. Mustafa Al Bakri, M.N. Norazian, H. Kamarudin1, M.A.A. Mohd Salleh, and A. Alida, (2013) Strength of Concrete Based Cement Using Recycle Ceramic Waste As Aggregate, Advanced Materials Research,Trans Tech Publications, Switzerland 740 (2013) 734-738.

[7] Chandana, Abhishek Mohanb, Samsher Anwarc, (2015) Experimental Analysis of Utilization of Stone Waste in Course Aggregate, International Journal Of Innovative Research In Technology, ISSN: 2349-6002, 2(7), 96-99.

[8] G.Murali, K.R.Jayavelu,N.Jeevitha,M.Rubini, N.R.Saranya,(2012) Experimental Investigation on Concrete with Partial Replacement of Coarse Aggregate, International Journal of Engineering Research and Applications (IJERA), ISSN: 2248-9622, 2(2), 322-327.

[9] http://realtyplusmag.com/ceramic-tiles-market-to-see-9-59-cagr-driven-by-residential-construction-industry-to-2020/.