International Journal of Recent Trends in Engineering & Research
ISSN (ONLINE) : 2455 – 1457
IMPACT FACTOR : 4.101

ICNSCET20- International Conference on New Scientific Creations in Engineering and Technology

Partial Replacement of Blast Furnance Slag and Ceramic Tiles for Coarse Aggregate in Concrete

S. Arunesh[1], R. Elangovan[2]

[1]*PG student, Department of Structural Engineering, M.I.E.T Engineering College, Tiruchirappalli, Tamil Nadu, India*

[2]*Assistant professor, Department of Civil Engineering, M.I.E.T Engineering College, Tiruchirappalli, Tamil Nadu, India*

ABSTRACT - Concrete is a versatile engineering composite material made with cement, aggregates and admixtures in some cases. Due to the day by day innovations and developments in construction field, the global consumption of natural aggregates is very high and at the same time production of solid wastes from the demolitions and manufacturing units are also very high.. Because of this reasons the reuse of demolished construction wastes and solid waste from manufacturing came into the picture to reduce the solid wastes from demolition and manufacturing units and as well as to decrease the scarcity of natural basic aggregate. To overcome the issues many research were done to use many industrial waste as alternative or substantial material for concreting. In this project control concrete is casted for M25 grade and the partial replacement of concrete materials were decided to reuse industrial waste such as blast furnace slag and ceramics tiles as coarse aggregate replacement in range of 20%, 30%, 40% by weight of 20mm sieve size coarse aggregate. Concrete mixtures were produced, tested and compared in terms of compressive strength to the conventional concrete. These tests were carried out to evaluate the mechanical properties for 7, and 28 days. This project work is concerned with the experimental investigation on strength and mechanical properties of concrete and optimum percentage of the partial replacement by replacing 20%, 30%, 40% of ceramic waste and blast furnace slag.

I. INTRODUCTION

`Generally in design of concrete mix, cement, fine aggregates and coarse aggregates are using from long back, which plays a crucial role in designing of a particular grade of concrete. But now a days there is a scarcity in aggregates. So, some new materials which are locally available for low cost have to introduce for replacing the fine aggregates, coarse aggregates and as well as cement to get the same strength as that these basic materials can give. So, we have to search for different materials to reduce the quantity of basic natural materials in the concrete mix without changing any mix design procedure and considerations. Use of cheaper material without loss of performance is very crucial to the growth of developing countries. We cannot replace the whole basic material in the concrete, but we can replace with other materials to some extent. In the present world, huge amount of solid wastes are obtaining from manufacturing units and demolitions of construction from human daily habitats. Some researchers are working on solid waste as partial replacing substances based on the locally available waste materials like crushed plastic, Stone dust, over burnt bricks, M – sand, glass powder, coconut shells, waste tires, slag, fly ash produced from industries, broken glass pieces, rice husk ash, coconut shell ash, etc., to use them in concrete to partially replace the

basic materials. And studies have been going on to preserve the natural basic aggregates and to promote use of the recycled aggregates to the next level in the concrete mix and to reuse the solid waste from construction again as a material in the concrete to decrease the land fill of solid waste and decrease the scarcity of natural aggregates like gravel and sand. Huge usage of ceramic tiles, Blast furnace slag other ceramic for architectural appearance, the productions of which are drastically increased. As 30to 40% of the total production from manufacturing units is solid waste. So, we selected these ceramics waste tiles and blast furnace slag as a replacement material to the basic natural aggregate.

A. Blast Furnace Slag

In the production of iron and steel, fluxes (limestone and/or dolomite) are charged into blast furnace along with coke for fuel. The coke is combusted to produce carbon monoxide, which reduces the iron ore into a molten iron product. Fluxing agents separate impurities and Slag is produced during separation of molten steel. BF slag is a non-metallic co-product primarily consists of silicates, alumina silicates, and calcium-alumina-silicates. The molten slag which absorbs much of the sulphur from the charge, comprises about 20 per cent by mass of iron production.

Figure 1. Blast Furnace Slag

B. Ceramics Waste

The principle waste coming into the ceramic industry is the ceramic powder, specifically in the powder forms. Ceramic wastes are generated as a waste during the process of dressing and polishing. It is estimated that 15 to 30% waste are produced of total raw material used, and although a portion of this waste may be utilized on-site, such as for excavation pit refill. The disposals of these waste materials acquire large land areas and remain scattered all around, spoiling the aesthetic of the entire region. It is very difficult to find a use of ceramic waste produced. Ceramic waste can be used in concrete to improve its strength and other durability factors. Ceramic waste can be used as a partial replacement of cement or as a partial replacement of fine aggregate sand as a supplementary addition to achieve different properties of concrete.

Figure 2. Ceramic tiles

Ceramic waste is a recycled aggregate is coming in to the ceramic industry. Ceramic waste is generated as a waste during the process of cutting, and marking. In this project study an attempt has been made to find the suitability of the ceramic industrial wastes as a possible replacement for conventional coarse aggregate. Mainly this type of recycled aggregate is used for the

developments of concrete with non-conventional aggregates to improve the properties of concrete and reduce the cost.

Objectives

- The main objective is to study the behavior of concrete by partial replacement of coarse aggregate with ceramic and blast furnace slag with different percentages of 20%,30% and 40% respectively and to find which is more effective and provides more strength.
- To find mechanical properties of concrete.

II. MATERIAL PROPERTIES

1.Cement

In the present study, Portland Pozzolanic Cement (PPC) of single batch was used throughout the investigation. The PPC used was confirming to IS1484: 1999. Fly ash based Portland Pozzolana cement of Birla Gold brand was used in the experiment. Initial setting time and final setting time are 240 minute and 315 minutes respectively. The specific gravity of cement is 3.15 & consistency is 30%.

2. Fine Aggregate

For the experimental study, sand acquired from natural River sand. Fine aggregate was confirming to IS 383: 1970. It was pass through 4.75 mm size of IS sieve having specific gravity of 2.31 was used.

3.Coarse Aggregate

Coarse aggregate obtain from local sources . 20 mm sieve size experimental purpose. Coarse Aggregate used in experimental study was confirming IS 383: 1970. The aggregate are sieved separately. Specific gravity and water absorption of these aggregate were 2.74 and 0.55 respectively.

4.Blast furnace slag

Blast furnace slag were obtained from local foundries and broken and crushed with 20mm sieve size.Its bulk density and water absorption were 1.305 g/cc and 2.59% respectively. And the value of impact strength and crushing strength of blast furnace slag is 14.70& 14.50 respectively.

5.Ceramics waste

The principle waste coming into the ceramic industry is the ceramic powder, Specifically in the powder forms. Ceramic wastes are generated as a waste during the process of dressing and polishing. It is estimated that 15 to 30% waste are produced of total raw material used, and although a portion of this waste may be utilized on-site, such as for excavation pit refill, The disposals of these waste materials acquire large land areas and remain scattered all around, spoiling the aesthetic of the entire region. It is very difficult to find a use of ceramic waste produced. Ceramic waste can be used in concrete to improve its strength and other durability factors. Ceramic waste can be used as a partial replacement of cement or as a partial replacement of fine aggregate sand as a supplementary addition to achieve different properties of concrete. Ceramic waste is a recycled aggregate is coming in to the ceramic industry. Ceramic waste is generated as a waste during the process of cutting, and marking. In this project study an attempt has been made to find the suitability of the ceramic industrial wastes as a possible replacement for conventional coarse aggregate. Mainly this type of recycled aggregate is used for the developments of concrete with non-conventional aggregates to improve the properties of concrete and reduce the cost.

Table 2. Physical properties of ceramic tiles

Properties	Test results
Specific gravity	2.39
Water absorption	2.2
Impact strength	14.37
Crushing strength	14.43

III. MIX DESIGN AND MIXING OF CONCRETE

Mix design is done for M25 grade of concrete as per IS 10262 :1982. Ceramic Tiles in the order of 20% and 30% ,40% is used in concrete with the mix ratio of M25. As per Indian standard Guidelines the mix design was carried out. The mix proportions of the concrete were 1:1.1:2:0.4 (Cement, Fine aggregate, Coarse aggregate and water/cement ratio). The mixing can be done by manual.

IV. RESULTS AND DISCUSSIONS

1. Compressive strength

From the table below it is found that partially replacing coarse aggregates with ceramics tiles and blast furnace slag provides an increase in the compressive strength of cubes having various percentages (20%,30%and 40%) of ceramics tiles and blast furnace slag when compared with conventional mix. For 20% replacement (10% blast furnace slag + 10%ceramics tiles) are partially replaced with coarse aggregate . For 30% replacement (15% of blast furnace slag + 15% of ceramics tiles)are partially replaced with coarse aggregate. For 40% replacement (20% of blast furnace slag +20%ceramics tiles) are partially replaced with coarse aggregate. Average Compressive strength is increased with 20% replacement respectively.

Table 3.Compressive strength test results at 7 & 28days

SI NO	MIX	7 DAYS STRENGTH (N/mm^2)	28 DAYS STRENGTH (N/mm^2)	AVERAGE OF INCREASING IN STRENGTH 28 DAYS
1	0%	27.77	35.11	-
2	20%	25.15	44.13	25.690%
3	30%	23.24	40.5	15.35%
4	40%	34.48	41.64	18.598%

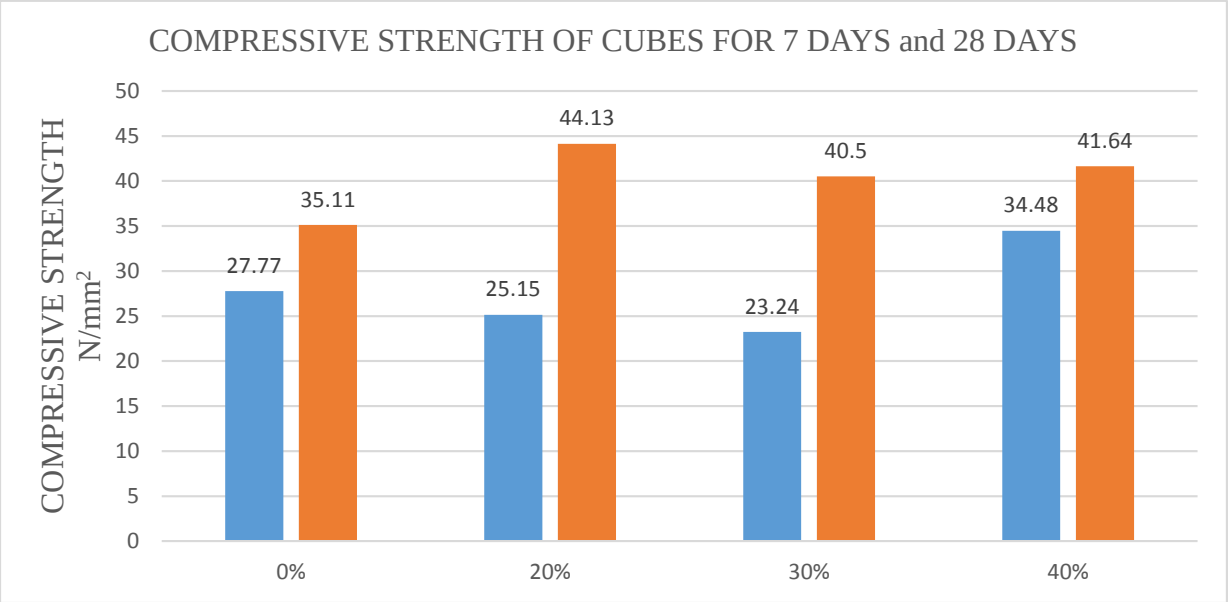

Figure 2. chart for compressive strength test

V. CONCLUSION

Replacement is done in concrete with ceramics tiles and blast furnace slag in coarse aggregate with different percentages of 20% ,30% and 40% respectively and to find the mechanical properties of concrete. Mix design for M25 had been carried out and cube, were casted. Compressive strength can be done. Average compressive strength is obtained in conventional mix is 30.64N/mm² and in replacement mix 44.1394N/mm² and average percentage of increase in compressive strength of concrete is 27.638%. Thus the mechanical strength of concrete is increased in replacing 20% and 30% blast furnace slag and ceramics tiles with coarse aggregate compared to conventional mix of concrete.

REFERENCES

[1] Parminder Singh and Dr.Rakesh Kumar Singla. Utilization Of Waste Ceramic Tiles As Coarse Aggregate In Concrete. Journal of Multidisciplinary Engineering Science and Technology (JMEST) Vol. 2 Issue 11, November - 2015 .

[2] SateeshBabu&Jani Sk. Effect Of Waste Ceramics Tiles In Partial Replacement Of Coarse And Fine Aggregate Of Concrete. International Advanced Research Journal In Science ,Engineering And Technology Vol 2,issue 6,june 2015.

[3] Hitesh Kumar, Mandavi ,and Vikas Srivastava. Durability of Concrete with Ceramic Waste as Fine Aggregate Replacement. International Journal of Engineering and Technical Research (IJETR) Volume-3, Issue-8, August 2015.

[4] Prasath, K.A., Krishnan, B.R. and Arun, C.K., 2013. Mechanical properties of woven fabric Basalt/jute fibre reinforced polymer hybrid composites. Int. J. Mech. Eng, 2(4), pp.279-290.

[5] Krishnan, B.R., Ramesh, M., Giridharan, R., Sanjeevi, R. and Srinivasan, D., Design and Analysis of Modified Idler in Drag Chain Conveyor. International Journal of Mechanical Engineering and Technology, 9(1), pp.378-387.

[6] Krishnan, B.R. and Ramesh, M., 2019. Experimental evaluation of Al-Zn-Al2O3 composite on piston analysis by CAE tools. Mechanics and Mechanical Engineering, 23(1), pp.212-217.

[7] J.Swathi.An Experimental Investigation On Concrete By Partial Replacementof Copper Slag For Fine Aggregateand Ceramic Waste With Coarse Aggregate. International Journal Of Emerging Technology In Computer Science & Electronics (Ijetcse) Issn: 0976-1353 Volume 13 Issue 4 – March 2015.

[8] Hiraskar and ChetanPatil. Use of Blast Furnace Slag Aggregate in Concrete. International Journal Of Scientific & Engineering Research, Volume 4, Issue 5, May 2013.

[9] Selwyn Babu1and Dr. N. Mahendran.Experimental Studies on Concrete Replacing Fine Aggregate with Blast Furnace Slag.International Journal of Engineering Trends and Technology (IJETT) – Volume 10 Number 8 - Apr 2014.

[10] Prem Ranjan Kumar, Dr. Pradeep Kumar T.B.Use of Blast Furnace Slag as an Alternative of Natural Sand in Mortar and Concrete.International Journal of Innovative Research in Science, Engineering and Technology Vol. 4, Issue 2, February 2015.

[11] M. Deenadayal Shyam Prasad Reddy, K. Midhun Kumar and M. Vasudeva Naidu. Assessment of Concrete Properties by Replacing Ceramic Waste as Coarse Aggregate by Two-Stage Mixing Approach. International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 5, Issue 8, August 2016.

[12] Mohammed Nadeem, Dr. A. D. Pofale.Replacement Of Natural Fine Aggregate With Granular Slag - A Waste Industrial By-Product In Cement Mortar Applications As An Alternative Construction Material. International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 Vol. 2, Issue 5, September- October 2012.

[13] A.Vengal RA.ChandraShekar and M.Prabhaker .Experimental Study of Coarse Aggregates and Fine Aggregates Replaced By Ceramic waste. International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 5, Issue 4, April 2016.

[14] KRISHNAN, B.R. and PRASATH, K.A., 2013. Six Sigma concept and DMAIC implementation. International Journal of Business, Management & Research (IJBMR), 3(2), pp.111-114.

