INTERNATIONAL RESEARCH JOURNAL IN ADVANCED ENGINEERING AND TECHNOLOGY (IRJAET) E - ISSN: 2454-4752 P - ISSN : 2454-4744
VOL 4 ISSUE 3 (2018) PAGES 3902 – 3908
RECEIVED : 05.05.2018 PUBLISHED : 10.06.2018

June 10, 2018

EFFECT OF PARTIAL REPLACEMENT OF COARSE AGGREGATE BY WASTE CERAMIC TILES AND CEMENY BY GROUND GRANULATED BLAST FURNACE

[1]Sakthi Prasad. R, [2]N. Selva Kumar

[1]Post Graduate Scholar, [2]Assistant Professor,

Department Of Civil Engineering
Global Institue Of Technology & Engineering, Vellore, India

Abstract:

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 the 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.On the Other hand, the GGBS is a by-product in the manufacture of iron and the amounts of iron and slag obtained are of the same order. Iron ore, coke and limestone are fed into the furnace and the resulting molten slag floats above the molten iron at a temperature of about 1500°C to 1600°C.In this experimental study, different mixes are cast, waste crushed tiles are used to partially replace the coarse aggregate by 10% , 20% and 30% and GGBS is used to partially replace the cement by 20%,30% and 40%. A total of 9 types of mixes of M30 grade were prepared. Results were upto the mark and it is very reliable compared to the normal concrete. It has better flexural strength than the normal concrete.

Keywords:Ceramic tiles, GGBS, Workability, Shrinkage, Flexural strength

I. INTRODUCTION

Concrete is the most widely used man-made product in the world, and is second only to water as the world's most utilized substance. Slightly more than a tonne of concrete is produced each year for every human being on the planet, some six billion tonnes a year. Concrete is an affordable and reliable material that is applied throughout the infrastructure of a nation's construction, industrial, transportation, defence, utility and residential sectors. Fundamentally, concrete is economical, strong and durable.Recycled aggregate utilizes demolition material from concrete, burnt clay brick masonry construction, waste ceramic tiles as aggregate. Reuse of demolition waste disposal is also helpful in reducing the gap between the demand and supply of crushed granite fresh aggregate. While the amount of demolition waste materials generated in India has not yet been quantified properly, it is thought that presently the yearly rate of demolition of buildings and other structures in the major cities has reached 1 to 2 percent.

This is mainly due to the following reasons:

- Demolition of structures, which have become obsolete either in serving the basic functions or due to structural deterioration.
- Demolition of structures for better economic gains (through new construction)
- Waste construction material formed due to natural disasters like earthquakes, cyclone and flood and War – inflicted damages.

Most of the waste materials produced by demolishing structures are disposed by dumping them as landfill or for reclaiming land. But with the demand for land increasing day by day, the locations, capacity and width of the land that can receive waste materials are becoming limited. In addition to that, the cost of transportation for disposal makes a major problem. Hence, reuse of demolition waste appears to be an effective solution, it is the most appropriate and large-scale use to produce concrete for new construction. After the Second World War, a number of European countries like Germany, England, Netherlands and Japan made their attempts to study and reuse demolition materials in the construction of civil engineering works.

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 the 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. On the other hand, nearly 1.4 tonnes of Ordinary Portland cement being produced yearly around the globe contributes to 5 percent of greenhouse gas, carbon dioxide, emissions worldwide. Not only burning fuel to heat the kiln emits carbon dioxide, but also decomposition of limestone emits even more gas. These identified problems clearly, contribute significantly to climate change. The ideal target to partly solve the above phenomenon is to develop a sustainable system loop which can turn resources which are land filled as waste materials into useful products in the construction industry, thus preserving the natural resources. The GGBS is a by-product in the manufacture of iron and the amounts of iron and slag obtained are of the same order. Iron ore, coke and limestone are fed into the furnace and the resulting molten slag floats above the molten iron at a temperature of about 1500°C to 1600°C. After the molten iron is tapped off, the remaining molten slag, which consists of mainly siliceous and aluminous residue is then water - quenched rapidly, resulting in the formation of a glassy granulate. This glassy granulate is dried and ground to the required size, the primary constituents of slag are lime (CaO) and silica (SiO_2). Portland cement also contains these constituents. The primary constituent of slag is soluble in water and exhibits an alkalinity like that of cement or concrete. Meanwhile, with the development of steel industry, the disposal of such a material as a waste is definitely a problem and it may cause severe environmental hazards.

2. MATERIALS USED AND MATERIAL PROPERTY

2.1 Cement

The cement used was ordinary Portland cement 53 (OPC 53).All properties of cement were determined by referring IS 12269 - 1987. The specific gravity of cement is 3.15. The initial and final setting times were found as 55 minutes and 258 minutes respectively. Standard consistency of cement was 30%.

2.2 Coarse Aggregate (CERAMIC TILES)

20mm-40 mm sized Ceramic tiles is used In this experimental study. As Ceramic tiles doesn't absorb water as like of normal coarse aggregate it can be used as an alternative

2.3 Fine Aggregate

The sand which was locally available and passing through 4.75mm IS sieve is used. The specific gravity of fine
aggregate was 2.60.

2.4 GGBS:

GGBS acts as pozzolana and is therefore combined with Portland cement, resulting in a hardened cement of GGBS combined with Portland cement, which has more of smaller gel pores and fewer larger capillary pores than that of normal Portland cement which consequently results in lower permeability and hence greater durability.

2.4 Water

The water used for experiments was potable water.

1.3. APPLICATIONS OF RECYCLED AGGREGATE

Traditionally, the application of recycled aggregate is used as landfill. Nowadays, the applications of recycled aggregate in construction areas are most common one. The applications are different from country to country

1.3.1 Concrete Kerb and Gutter Mix

In Australia, Recycled aggregate have been used as concrete kerbs and gutter mix. According to Building Innovation & Construction technology (1999), Stone says that the 10mm recycled aggregate and blended recycled sand are used for concrete kerbs and gutter mix in the Lent hall Street project in Sydney.

1.3.2 Paving Blocks

- Recycled ceramic tiles can be used as Paving Blocks
- Especially this Paving Blocks manufactured by recycled ceramic tiles is mainly used in parking area because of its low costs.

Fig Paving Blocks

1.3.3 Backfill Materials

- Recycled ceramic tiles can be used as backfill materials.

.

INTERNATIONAL RESEARCH JOURNAL IN ADVANCED ENGINEERING AND TECHNOLOGY (IRJAET) E - ISSN: 2454-4752 P - ISSN : 2454-4744
VOL 4 ISSUE 3 (2018) PAGES 3902 – 3908
RECEIVED : 05.05.2018 PUBLISHED : 10.06.2018
June 10, 2018

1.3.4 Granular Base Course Materials

Recycled aggregate are used as granular base course in the road construction. It also stated that recycled aggregate had proved that they are better than natural aggregate when it is used as granular base course in roads construction. They also found that when the road is built on the wet sub grade areas, recycled aggregate will stabilize the base and provide an improved working surface.

Fig Granular Base Course Materials

1.3.6 Embankment Fill Materials

Market study for Recycled Aggregate which is done in 2001 stated that recycled aggregate can be used in embankment fill. The reason for use in embankment fill is quite same as it is used in granular base course construction. The embankment site is on the wet sub grade areas. Recycled aggregate can stabilize the base and provides an improved working surface for the remaining works.

1.10 PRODUCTION OF CERAMIC TILES

Ceramic tiles are mostly produced for certain
Followings.

- Wall and Floor tiles
- Brick and Roof tiles.
- Refractory materials
- Sanitaryware.

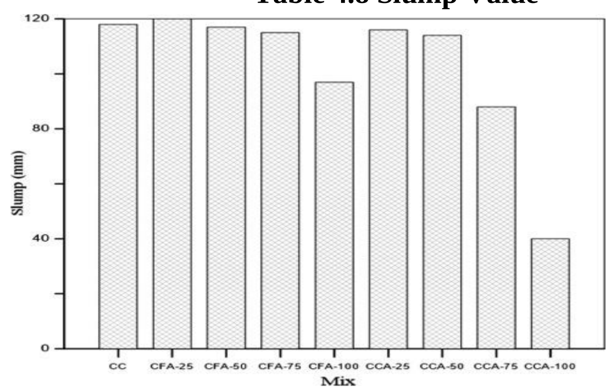
The mix proportion then becomes for 1 m^3

INTERNATIONAL RESEARCH JOURNAL IN ADVANCED ENGINEERING AND TECHNOLOGY (IRJAET) E - ISSN: 2454-4752 P - ISSN : 2454-4744
VOL 4 ISSUE 3 (2018) PAGES 3902 – 3908
RECEIVED : 05.05.2018 PUBLISHED : 10.06.2018
June 10, 2018

5.2.1Slump Test

The slump is taken for each mixing of concrete with replacement 10%, 20%, 30% of Ceramic tiles and 20%, 30%, 40% replacement of GGBS. The results show that slump of concrete made with natural aggregates is higher while the concrete with 100% replacement of Ceramic tiles has less slump. The low slump in Ceramic tiles is caused by the low water absorption during the mixing process and GGBS exhibits pozzolanic property but rarely if any self hardening property.

Table 4.8 Slump Value



Specimen

5.2.2 Compaction Factor test

Compacting factor test also used to determine the workability of fresh concrete. It is not used on site testing because the apparatus is very heavy. According to Street works the compacting factor test gives a more accurate workability of fresh concrete than slump test. It mentioned that the compacting factor test also known as the "drop test", which measures the weight of fully compacted concrete and compare it with the weight of partially compacted concrete.

5.3 TESTS ON HARDENED CONCRETE

5.3.2 COMPRESSIVE STRENGTH TEST

The compressive strength test is used to determine the characteristics strength of the concrete. The aim of this experimental test is to determine the maximum load carrying capacity of test specimens.

Specimens	Replacement Of Ceramic tiles	Replacement Of GGBS	Average Compressive Strength 7 Days N/mm^2	Average Compressive Strength 14 Days N/mm^2	Average Compressive Strength 28 Days N/mm^2
Conventional	-	-	27.1	31.21	34.87
TRIAL 1	0 %	0 %	27.1	31.21	34.87
		50 %	25.44	29.92	32.42
		100 %	20.32	28.26	28.65
TRIAL 2	25 %	0 %	24.34	28.62	32.21
		50 %	23.12	27.57	30.31
		100 %	20.42	25.52	28.21
TRIAL 3	35 %	0 %	23.64	28.16	30.22
		50 %	21.73	25.92	28.32
		100 %	19.77	23.47	26.44
TRIAL 4	55 %	0 %	21.38	24.82	28.81
		50 %	19.89	23.92	26.02
		100 %	17.92	20.12	23.54

Table 5.0 Compressive Strength Test Results at 7, 14 & 28 days

5.3.3 SPLIT TENSILE STRENGTH TEST

The tensile strength is one of the basic and important properties of the concrete. The concrete is not usually expected to resist, the direct tension because of its low tensile and brittle in nature. However the determination of tensile strength of concrete is necessary to determine the load at which The concrete members crack. The cracking is a form a tensile failure. The main aim of this experimental test is to determine the maximum load carrying capacity of test specimens during tension. Size of cylinders 150 mm in diameter and 300 mm height were cast for split tensile test. The crude oil was applied along the inner surfaces of the mould for easy removal of cylinder from the mould. Concrete was poured throughout its length and compacted well.

A. References

The heading of the References section must not be numbered. All reference items must be in 8 pt font. Please use Regular and Italic styles to distinguish different fields as shown in the References section. Number the reference items consecutively in square brackets (e.g. [1]). When referring to a reference item, please simply use the reference number, as in [2].

Examples of reference items of different categories shown in the References section include:

- example of a book in [1]
- example of a book in a series in [2]
- example of a journal article in [3]
- example of a conference paper in [4]
- example of a patent in [5]
- example of a website in [6]
- example of a web page in [7]
- example of a databook as a manual in [8]
- example of a datasheet in [9]
- example of a master's thesis in [10]
- example of a technical report in [11]
- example of a standard in [12]

CONCLUSION

The version of this template is V2. Most of the formatting instructions in this document have been compiled by Causal Productions from the IEEE LaTeX style files. Causal Productions offers both A4 templates and US Letter templates for LaTeX and Microsoft Word. The LaTeX templates depend on the official IEEEtran.cls and IEEEtran.bst files, whereas the Microsoft Word templates are self-contained.

ACKNOWLEDGMENT

The heading of the Acknowledgment section and the References section must not be numbered. Causal Productions wishes to acknowledge Michael Shell and other contributors for developing and maintaining the IEEE LaTeX style files which have been used in the preparation of this template.

REFERENCES

[1] "Concrete Technology" Theory and practice, A text book by M.S.Shetty, 2005.

[2] Correia, J.R., de Brito, J. and Pereira, A.S., "Effects on Concrete Durability of Using Recycled Ceramic Aggregates", Material and Structure,Vol.39 (2), pp.169-177, 2006

[3] Durai S. Asst Divisional Engineer, Highway Department, Nammakal, Tamil NaduIndia., Remya M. Post Graduate Student, Department of Civil Engineering, Sri Krishna College of Technology, Coimbatore, India. "Experimental Investigation On High Performance Concrete Using GGBS As Admixture".

[4] Khaloo, A. R., "Crushed Tile Coarse Aggregate Concrete", Cement and Concrete Aggregate, Vol.17, pp.119-125, 1995.

[5] Tamilarasan V.S (2012), "Workability Studies on Concrete with GGBS as a Replacement Material for Cement with and without Super plasticizer", International journal of advanced research in engineering and technology, Vol.3, Issue 2, pp.11-21

[6] Tavakoli D, A.Heidari and M.Karimian "Properties of Concrete Produced with Waste Ceramic Tile Aggregate", Asian Journal of Civil Engineering, Vol. 14 No.3, Pp. 369-382, 2013.

[7] Topcu B and Canbaz, "Utilization of Crushed Tile as Aggregate in Concrete", Iranian Journal of science & technology, Transaction B, Engineering, Vol. 31, No. B5, pp561-565.

[8] Senthamarai, R.M and Manhoharan, P.D., "Concrete with Ceramic Waste Aggregate", Cement and Concrete Composites, Vol.27, pp.910-913,2005.