EXPERIMENTAL STUDY ON CONCRETE WITH THE USE GGBS AND CERAMIC WASTE

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Abstract—The requirements of the use of wastes from Steel Industries and Ceramic Industries have increased due to the rapid evolution. These wastes are very unsafe for the atmosphere if not properly disposed. Nowadays the use of Industrial wastes is in landfill, but this paper represents the innovative use of these wastes in the concrete industry. The u se of this waste gives a good support to depleting stock of Cement.
In this study, the behaviour of GGBS and Ceramic Waste in concrete is examined by the replacement of percentage variation of Cement with the GGBS and Ceramic Waste for the determination of structural property.
The replacement of Cement with GGBS is up to 15% with the interval of 5% and with Ceramic Waste is fixed 10% By Weight.
All replacement had done with the same water cement ratio. In this paper the water cement ratio of 0.50 was used.

Index Terms—Minimized waste, protect environment, cost economy, slump test, compacting factor test, compressive strength, split tensile strength test, water absorption test.

INTRODUCTION

In the recent state of affairs the resources used for the developments and globalization is more of having cement and carbon content. By the result of this, the use of the materials which not affects the environment and also how the Morden technologies can help the sustainable developments.

Many types of studies have been done on the materials like fly ash, GGBS, glass paper, agro waste, plastics, and other admixtures. These materials generally replace the main components of the concrete like cement, aggregate, and sand.

The objective of this project is to use GGBS and Ceramic Waste as a construction material. The second objective is to evaluate the strength and durability of the concrete with the GGBS and Ceramic Waste as a replacement of cement with different percentages.

GGBS is available from the production of iron and sometimes it has been treated as a waste, by the use of GGBS in the concrete will decreased the environment problems. The main objective of the project is to reduce the use of cement by using different percentages of GGBS. In Gujarat 20% waste has been generated by the industries and that waste will not be properly disposed, so by the use of the waste we can reduce the waste disposal and use that waste in the concrete with different percentages.

The high consumption of raw materials by the construction sector, results in chronic shortage of building materials and the associated environmental damage. In the last decade, the construction industry has been conducting various researches on the utilization of industrial waste products in concrete in order to reduce the utilization of natural resources. India is a pioneer in the exploration, ceramic waste and GGBS utilization from ceramic waste and iron industries. The study concerns mainly on the possible use of ceramic waste in construction industry, which would reduce both environmental impacts and the production cost. Concrete works in the construction industry are particularly important as it is not only responsible for consuming natural resources and energy but also its capacity to absorb other industrial waste. Presently large amounts of ceramic wastes are generated in natural ceramic and steel processing plants with an important impact on the environment due to its disposal. Ceramic powder and Granulated Ground Blast Furnace Slag are generated as a waste during the process of cutting and polishing of Tiles and Steel. This Research Study describes the feasibility of using the ceramic Waste powder and GGBS in concrete production as partial replacement of cement to reduce disposal and pollution problems. As a powder form are being an important part of concrete by volume and cost. Too, it's necessary to find an effective alternative to reduce the overall cost of concrete without affecting its properties.

So to main objective is to put in order the concrete having the Cement, Aggregates, Sand, GGBS, Ceramic waste and other admixture.

SIGNIFICANCE OF THE WORK

1 To evaluate the strength of concrete with the use of GGBS and Ceramic waste.
2 To review available literature for GGBS and ceramic waste and on the base of that to do some experiments.
3 To devise detailed experimental programmed usage of GGBS with Ceramic waste.
4 To investigate the various proportion of GGBS and Ceramic waste in the mix design.
5 To compare results of various proportion of GGBS and Ceramic waste in the mix design by following test
a. Compressive Strength Test (at 7, 14 and 28 days)
b. Water absorption test (at 28 days)
c. Durability Test (Effect of NaCl Water)
d. Split Tensile Test (at 7, 14 and 28 days)

MATERIALS

Cement

Ordinary Portland cement (OPC) of Ultra Tech 53 grade conforming IS: 12269, 1987 was used.

Table 1 Physical Properties of Cement

Sr No.	Property/Test	Results
1	Normal Consistency	29%
2	Fineness of cement (%)	7
3	Specific Gravity	3.24
4	Initial setting time	30 mins
5	Final setting time	189 mins
6	Compressive strength at 7 Days	41.90 N/mm2
7	Compressive strength at 28 Days	59.50 N/mm2

Natural Fine Aggregate

Natural Fine Aggregate used for the whole study was obtained from river sand conforming to zone I of IS: 383, 1987. The size of aggregate is less than 4.75mm.

Table 2 Physical Properties of Fine Aggregates

Sr No.	Property/Test	Results
1	Specific gravity	2.78
2	Water absorption	1.1 %
3	Moisture content	Nil

Natural Coarse Aggregate

Machine crushed granite chips conforming to IS: 383, 1970 of maximum size 20mm size of aggregate obtained from the local quarry was used and the specific gravity of 2.78.

Table 3 Physical Properties of Course Aggregates

Sr No.	Property/Test	Results
1	Specific gravity	2.78
2	Water absorption	1.48 %
3	Moisture content	Nil

Granulated Ground Blast Furnace Slag (GGBS)

The Slag was production house of The Stallion Energy PVT. LTD. Rajkot.

Ceramic Waste

The Ceramic Waste was production house of The Stallion Energy PVT. LTD. Rajkot.

Table 4 Properties of GGBS and Ceramic Waste Powder

Compressive Strength (N/mm2)		
Day	**Required As Per BS:6699:1996**	**Result Obtained**
07 Day	12.00 Min	23
28 Day	32.50 Min	42
Setting Time (Mortar: - 30% Cement & 70 % GGBS)		
Initial Setting Time	165	Not More Than Cement
Final Setting Time	400	Not More Than Cement
Specific Gravity of Material		
Sr No.	**Material**	**Result Obtained**
1	GGBS	2.91
2	Ceramic Waste Powder	2.89

MIX PROPORTIONING

Design of concrete mix as per the water cement ratio of 0.50 conventional batch was casted and then compared with the percentage replacement of the cement with GGBS and Ceramic Waste. Conventional mix design from the concrete design as per code IS: 10262, 2009 is given below.

Table 5 Calculated Mix Design

	Water	Cement	F.A.	C.A
By Weight (kg/m^3)	197.30	394.60	509.034	1041.744
By Volume	0.5	1	1.21	2.6

Table 6 Description of Different Mixtures

Concrete Block Mixes	Description
A	Standard Block
C1	5% & 10% Replacement of Cement By GGBFS and Ceramic Waste Respectively
C2	10% & 10% Replacement of Cement By GGBFS and Ceramic Waste Respectively
C3	15% & 10% Replacement of Cement By GGBFS and Ceramic Waste Respectively

Table 7 Different Mixtures with Unit Weights

Constituent	Unit	Mixture-1	Mixture-2	Mixture-3	Mixture-4
		A	C1	C2	C3
Water	Kg/m3	197.30	197.30	197.30	197.30
Cement		394.60	335.41	315.68	295.95
Fine Aggregate		509.034	509.034	509.034	509.034
Course Aggregate		1041.744	1041.744	1041.744	1041.744
GGBS		-	19.73	39.46	59.19
Ceramic Waste		-	39.46	39.46	39.46

EXPERIMENTAL WORK

Casting and Curing of Specimens

Casting of specimens was done by proper batching of materials, preparation of moulds and placing of concrete in the moulds. The vibrator was used and then the top surface was properly levelled at the end. Then all moulds are allowed to dry for 24 hours and proper batch for identification were written and kept into curing tank for 7, 14 and 28 days.

Slump Test for the Fresh Concrete

The slump test was done for the comparison of degree of workability between natural concrete and other mixtures of concrete. By increasing the percentage of GGBS and Ceramic Waste the slump value were low but it gives more workability so that the values were very near as per mix design. So without any admixtures the workability criteria was satisfied by using selected wastes.

Strength Tests

The compressive strength tests were done with the size of specimen 15cmx15cmx15cm. The cubes were tested after curing of 7 days, 14 days and 28 days from the date of casting. The work of casting, curing and testing was done in the proper manner. Cylinders were 15cm diameter and 30cm height of size used for split tensile strength. Obtained results of each test are given below in tabular form for water cement ratio 0.50.

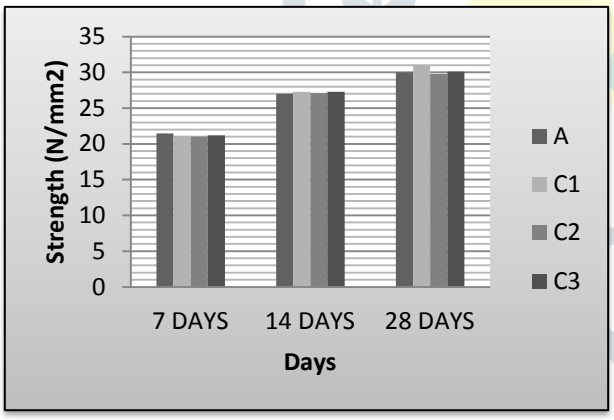

FIGURE 1 COMPRESSIVE STRESS

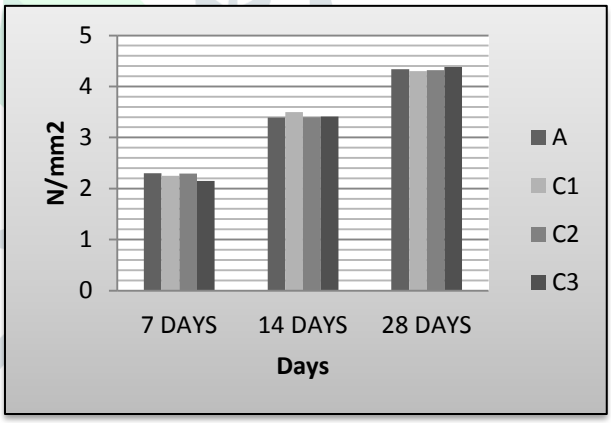

FIGURE 2 SPLIT TENSILE TEST

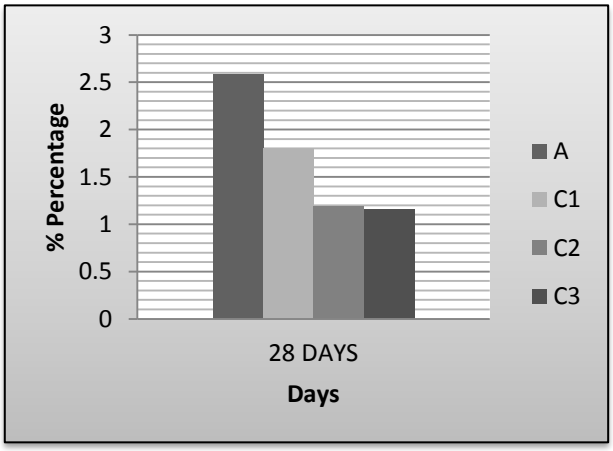

FIGURE 3 WATER ABSORPTION TEST

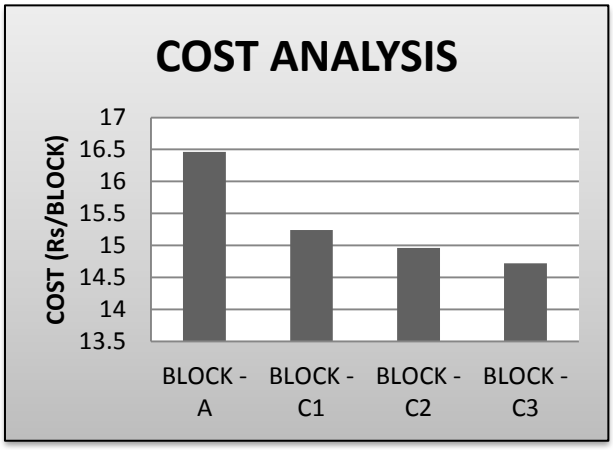

FIGURE 4 COST ANALYSIS

CONCLUSION

Based on experimental investigations of Compressive Strength, Water absorption, Durability and of Solid Concrete blocks cast with different proportions of GGBS and Ceramic Waste the following conclusions are drawn out for different parameters.

1. Results show that optimum GGBS and Ceramic Waste replacement for highest compressive strength is 15% and 10% respectively at 28 days compare to the standard solid concrete blocks.
2. Result shows that optimum GGBS and Ceramic Waste replacement for highest split tensile test is 15% and 10% respectively at 28 days compare to the standard solid concrete blocks.
3. For replacement of GGBS with cement, when increasing the percentage of the GGBS and in solid concrete blocks water absorption of solid concrete blocks gives negligible change.
4. Ceramic Waste absorbs less water compare to the Cement and also effect of Heat of Hydration Decrease.
5. With increasing the percentages of GGBS and Ceramic Waste in solid concrete blocks are decreasing the total cost per block.

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FUTURE SCOPE

Following are the various recommendations which can be done with the future experimental work,

1. Waste generation from GGBS and Ceramic Waste industries is high; so effort should be done in the direction to reduce the wastage and effective utilization of this waste.
2. Utilization of GGBS and Ceramic Waste industries waste in other value added products like paver blocks, bricks and concrete products.
3. Use various supplementary materials like GGBS and Ceramic Waste, foundry sand, slag, hypo sludge in solid concrete blocks for the economical purpose.

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