International Journal of Scientific & Engineering Research Volume 10, Issue 3, March-2019
ISSN 2229-5518

Experimental Study On The Effects Of Ggbs,Rha As Supplementary Cementious Material On The Properties Of Concrete With Addition Of Steel Fibers

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Abstract— T Concrete occupies a unique position among the modern construction materials. Concrete is a material used in building construction, consisting of a hard, chemically inert particulate substance, known as aggregate (usually made for different types of sand and gravel), that is bonded by cement and water. This paper presents an experimental investigation carried out to characterize the optimum percentage of Ground granulated blast furnace slag, Rice husk ash with steel fibre. The concrete industry is constantly looking for supplementary cementious material with the objective of reducing the solid waste disposal problem. This is done to meet the strength requirements in compression and split tension along. The steel fibers are used to increase the strength of concrete. The use of waste materials like fly ash, microsilica, rice husk ash, and ground granulated blast furnace slag which are hazardous to the environment may be used as a partial replacement for cement and in addition by utilizing the industrial wastes in the useful manner the environment pollution is reduced to a greater extent and which leads to sustainable development. Specimens are casted with M30 concrete. The work also focuses on M30 concrete with replacement of cement by GGBS with 20% and 30% and 40% and Rice Husk ash is kept constant with 10% replacement. To save our earth resources and to control the pollution from the manufacturing of cement waste materials like RHA and GGBS production of blended cements results in lower emission and lower energy consumption since less clinker from the energy intensive process is needed to produce

Index Terms— GGBS, RHA, Cement, Sand, aggeregate ,steel fibers,plastisizer, Mixture.

1 INTRODUCTION

Concrete is the most widely used man-made construction material in the world. It is obtained by mixing cementitious materials, water, aggregate and sometimes admixtures in required proportions. Fresh concrete or plastic concrete is freshly mixed material which can be moulded into any shape that hardens into a rock-like mass known as concrete. The hardening is because of chemical reaction between water and cement, which continues for a long period leading to stronger with age. Strength was emphasized without a thought on the durability of structures. The Ordinary Portland Cement (OPC) is one of the main ingredients used for the production of concrete and has no alternative in the construction industry. Use of cement alone as a binder material produces large heat of hydration. Since the production of this raw material produces lot of CO2 emission. The carbon dioxide emission from the cement raw material is very harmful to the environmental changes. Nowadays many researchers have been carried out to reduce the CO2.Hence it is inevitable either to search for another material or partly replace it by some other material. The search for any such material, which can be used as an alternative or as a supplementary for cement should lead to global sustainable development and lowest possible environmental impact. The effective way of reducing CO2 emission from the cement industry is to use the industrial by products or use of supplementary cementing material such as Ground Granulated Blast Furnace Slag (GGBS), Fly Ash (FA), Silica Fume (SF) and Metakaolin (MK). The concept of using fibers in concrete to improve resistance to cracking and fragmentation is old and intuitive. During the last 30 years different types of fibers and fiber materials were introduced and are being continuously introduced in the market as new applications. These fibers can be made of metals, natural, glass or organic materials. In the past three decades, extensive research on fiber reinforced concrete has shown that some types of fibers can be added to concrete to improve its durability and physical properties such as cracking induced by plastic shrinkage, drying shrinkage and thermal gradient on the surface of fresh and mature concrete due to the severe environmental conditions.

The process of selecting suitable ingredients of concrete and determining their relative amounts with an objective of producing a concrete of required strength, durability, and workability as economically as possible is termed as concrete mix design. The Mix Design for concrete M30 grade is being done as per the Indian Standard Code IS: 10262-1982

2 PROCEDURE FOR PAPER SUBMISSION

2.1 Review Stage

Detailed Supplementary cementitious materials (SCMs) have been widely used all over the world in ready-mixed concrete due to their economic and environmental benefits; hence, they have drawn much attention in recent years. Whether deriving from industrial waste, agro-waste or by-products, supplementary cementitious materials can be mixed with blended cement to enhance concrete strength. Supplementary cementitious materials may contain fly ash (FA), silica fume (SF), ground granulated blast furnace slag (GGBFS), rice husk ash (RHA), metakaolin (MK) and palm oil fuel ash (POFA). The utilization of these materials in concrete can partially reduce the consumption of Portland cement, which, in turn, can lessen construction costs, providing materials suppliers, contractors and engineers with substantial advantages. Furthermore, despite the drawbacks of their binary blends, the combination of supplementary cementitious materials can lead to many advantages, such as optimized strength, workability and durability. Unfortunately, these advances have not been fully taken into consideration in state specifications. Hence, by adopting a review approach, this study aimed to provide new insights into the effect of the incorporation supplementary cementitious materials on the properties of mortar and concrete.

2.2 Final Stage

For Testing of hardened concrete plays an important role in controlling and confirming the quality of cement concrete words. Systematic testing of raw materials, fresh concrete and hardened concrete are inseparable part of any quality control program for concrete, which helps to achieve higher efficiency of the material used and greater assurance of the Performance of the concrete with regard to both strength and durability. The test methods should be simple, direct and convenient to apply.

One of the purposes of testing hardened concrete is to confirm that the concrete used at site has developed the required strength. As the hardening of the concrete takes time, one will not come to know, the actual strength of concrete for some time. This is an inherent disadvantage in conventional test. But if strength of concrete is to be known at an early period, accelerated strength test can be carried out to predict 28 days strength. But mostly when current materials are used and careful steps are taken every stage of the work, concrete normally give the required strength. The test also has a deterring effect of those responsible for construction work. The results of test on hardened concrete even if they are known late, help to reveal the quality of concrete and enable adjustments to be made in the representative concrete or cores cut from the actual concrete. It is to be remembered that standard compression test specimens give a measure of the potential strength of the concrete structure cannot be directly obtained from tests on separately made specimens.The strength Criteria includes the following parameters

Compressive Strength on cubes

Split tensile strength on cylinders

2.3 Experimental Ivestigation

The main aim of this project is to study the compression,

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Split tensile and flexural behavior of concrete cubes, cylinders and prisms. The experimental programme consists of casting and testing of specimens IJSER copyright form must accompany your final submission.

3 TEST ON FRESH CONCRETE

Testing of hardened concrete plays an important role in controlling and confirming the quality of cement concrete works. Systematic testing of raw materials, fresh concrete and hardened concrete are inseparable part of any quality control program for concrete, which helps to achieve higher efficiency of the material used and greater assurance of the performance of the concrete with regard to both strength and durability. The test methods should be simple, direct and convenient to apply.

One of the purposes of testing hardened concrete is to confirm that the concrete used at site has developed the required strength. As the hardening of concrete takes time, one will not come to know the actual strength of concrete for some time. This is an inherent disadvantage in conventional test. But if strength of concrete is to be known at an early period, accelerated strength test can be carried out to predict 28 days strength. But mostly when correct materials are used and careful steps are taken at every stages of the work, concrete normally give the required strength. The test also has a deterring effect of those responsible for construction work. The results of test on hardened concrete even if they are known late, help to reveal the quality of concrete and enable adjustments to be made in the production of further concrete. Tests are made by casting cubes or cylinder from the representative concrete or cores cut from the actual concrete. It is to be remembered that standard compression test specimens give a measure of the potential strength of the concrete structure cannot be directly obtained from tests on separately made specimens.

4 SLUMP TEST

Fresh unsupported concrete flows down and the vertical settlement is known as slump. In the slump test fresh concrete is filled in a mould of specified shape and dimensions. Settlement of slump is measured when the mould is removed. 4.4.2 5 **PROCEDURE**

The internal surface of the mould is thoroughly cleanedand then the mould should be placed in horizontal rigid and non- absorbent surface. The mould shall be tamped with 25 strokes at four layers.The strokes shall be distributed in a uniform manner.The bottom layer tamped out throughout the depth.

6 OBSERVATION

Height of mould = 30 cm

Height of concrete obtained after removal of mould = 30 – 17

= 13 cm

5 Figures and Tables

Ground Granulated Blast furnace slag (GGBS) is a by-product of pig iron and is obtained through rapid cooling by water or by quenching molten slag. The replacement of cement with GGBS will reduce the unit water content necessaryto obtain the same slump. This reduction of water content is more pronounced with increasein slag content and also on the fineness of slag. The GGBS was purchased from AASTRA Chemicals,Chennai**Properties of GGBS**

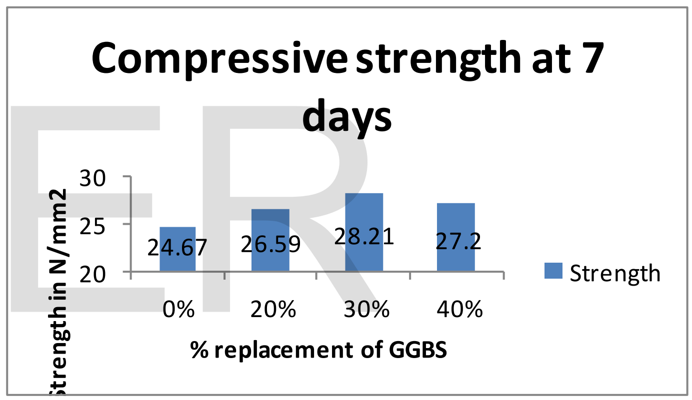
S.NO	CHARACTERISTICS	REQUIREMENT AS PER BS: 6699	TEST RESULT
1	Fineness (M / Kg)	275 (MIN)	390
2	Specific Gravity		2.85
3	Particle Size (Cumulative %)	45 MICRON	97.10
4	Insoluble Residue (%)	1.5 (Max)	0.49
5	Magnesia. Content (%)	14.0 (Max)	7.73
6	Sulphide Sulphur (%)	2.00 (Max)	0.50
7	Sulphite Content (%)	2.50 (Max)	0.38
8	Loss On Ignition (%)	3.00 (Max)	0.26
9	Manganese Content (%)	2.00 (Max)	0.12
10	Chloride content (%)	0.10 (Max)	0.009
11	Glass Content (%)	67 (Min)	91
12	Moisture Content (%)	1.00 (Max)	0.10
13	Chemical Moduli		
A	CaO + MgO + SiO2	66.66 (Min)	76.03
B	(CaO + MgO) / SiO2	> 1.0	1.30
C	CaO / SiO2	< 1.40	1.07

5.2 Compressive Strength

Cubical specimens of size 150 mm were cast for conducting compressive strength test for each mix. The compressive strength test was carried out as per IS: 516-1979. This test was carried at the end of 7 days, 14 days and 28 days of curing. The compressive strength of any mix was taken as the average of strength of three cubes.

% of Replacement of GGBS	% of RHA added	% of steel fiber added	Compressive Strength in N/mm²
0	10	1	24.67
20	10	1	26.59
30	10	1	28.21
40	10	1	27.20

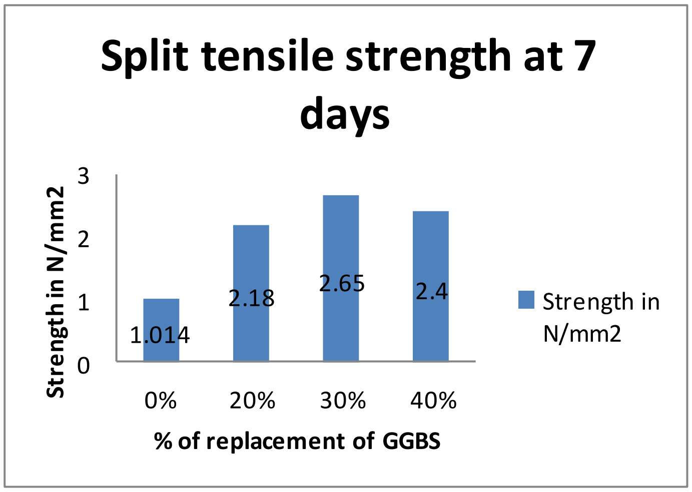
From the above table , it is found that initially the compressive strength value decreased and then increased to 28.21N/mm² for 30% replacement. Further increase in the percentage, tends to lower the strength values in test. The strength value got decreased to 27.20 N/mm² for 40% replacement GGBS but slightly increased than normal concrete which was found to be 24.67N/mm².



5.3 Split Tensile Strength

The split tensile strength is the indirect measurement of the tensile strength by placing a cylindrical specimen horizontally between the loading surfaces. This method consists of applying a diametric compressive force along the length of a cylindrical specimen. This loading includes tensile stresses on the plane containing the applied load. Tensile failure occurs rather than compressive failure

% of Replacement of GGBS	% of RHA Added	% of steel fiber added	Split Tensile Strength in N/mm²
0	10	1	1.014
20	10	1	2.18
30	10	1	2.65
40	10	1	2.40



6 Appendices

Design Stipulation

For M30 Mix design was done by Indian standard method.
Characteristic compressive strength at 28 days =30N/mm2
Specific gravity of cement =3.15
Specific gravity of fine aggregate =2.74
Specific gravity of coarse aggregate =2.74
Fineness of cement =0.33
Fineness of fine aggregate =2.75
Fineness of coarse aggregate =6.64
Type of exposure = severe
Degree of quality control =good
Grade of cement =53 grade
Water absorption of coarse aggregate = 0.5%
Water absorption of fine aggregate = 1%
Chemical admixture = Super Plasticizer

Mix design

Target mean strength = fck+ts
fck = target average compressive strength at 28 days
fck = characteristic compressive strength at 28 days
S = standard deviation
t = a statistical value depending upon the accepted proportion of low results and the number of results
Fck = 30N/mm2
From table 2(is 10262-1982) t =1.65
Table 1 s =5
Target mean strength =30+(1.65×5) =38.25 N/mm2
Average water content =0.46
Selection of water and sand
Water content per cubic meter of concrete =186 L/m3
Required water content =186 + (186×6/100) =197 l/m3
Assuming that using plasticizers the content may be reduced up to 20%
By reduction up to 11 % = 197 x 0.89 = 175.33 lit Determination of cement content
W/c ratio =0.45 Water content =197 l/m3
Cement =175.33 /0.45 =389.62 kg/m3 [From table 5 IS 456:2000] Minimum cement content for severe exposure condition is 320 kg/m3 389.62>320 hence ok

Proportion of volume of coarse and fine aggregate From table 3, Volume of CA corresponding to 20mm size and FA zone 1 for w/c ratio of 0.5 is 0.6.
W/c = 0.4 As the w/c ratio is lower by 0.10
the proportion of volume of CA is increased by 0.02.
Therefore corrected proportion of volume of CA for the w/c ratio of 0.40 is 0.6
For pumpable concrete the value shall be reduced by 10%
Volume of CA = 0.61
Volume of FA = 1-0.61 = 0.39
Mix Calculation
(a) Volume of concrete =1m3
(b) Volume of cement = 389.62/(3.15 * 1000) = 0.124 m3 (c) Volume of water
= 175.33/1000 = 0.175 m3
(d) Volume of Chemical Admixtures = (7.8/1.062) x(1/1000) = 0.00735 m3
(e)Volume of all in aggregate = a-(b+c+d)=
=1- (0.124+0.175+0.00735) = 0.693m3
(f) Mass of CA = d*vol of CA*sp.Gravity of CA *1000 = 0.693*0.61* 2.74*1000 = 1158.28 kg (g) Mass of FA = d*vol of FA*sp.Gravity of FA *1000 = 0.693*0.39* 2.74*1000 = 740.53 kg

7Acknowledgments

I would like to praise and thank the almighty God who is with us and has backed us powerfully throughout this project work.My special thanks to the chairman of our college, Mr. S.A SUBRAMANIAN, JCT college of Engineering and Technology, Pichanur for his support in the execution of the project.With great pleasure and privilege I express my sincere thanks and gratitude to our principal Dr. G.RAMESH M.E.,Ph.D for providing me with necessary facilities needed for the project completion. I Am also thankful to Head of the Civil Engineering department Prof. A.KUMAR, M.E.(,Ph.D) for his immense care and guidance throughout my project work.I would like to thank from the bottom of my heart and express my sincere gratitude to my guide, Ms. JEBITTA.P, M.Tech., for her valuable advice and constant encouragement, which helped me to finish the project successfully.I would like to thank my parents and family members, without their love, patience and support; I could not have completed this work.
Finally, it is indeed my privilege to my profound gratitude to all the staff nmembers of the department, classmates and friends, whose continuous encouragement and suggestions have been a great source of inspirations to me.

8Conclusion

In this experimental programme, cubes, cylinders were casted and tested up to failure. Then the behaviors of the tested cubes and cylinders were studied.
It was concluded that
Maximum compressive strength, split tensile strength and flexural strength is obtained for replacement of cement by 30% GGBS. Beyond 30 % there is marginal decrease in strength of concrete.The rate of gain of compressive strength of GGBS is slow at initial stages and as curing period increases the strength also increases.GGBS and steel fibers can be used in concrete as suitable

replacement of cement to make concrete strong in both compression and tension and also the use of RHA makes the concrete lighter. Replacing the cement with GGBS keeping RHA and steel fibers is one of the good solutions available to the problem of environmental impacts.

It was found that the use of GGBS, RHA and steel fibers in concrete increases the compressive, split tensile and flexural strength of concrete.

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