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EVALUATING THE STRENGTH BEHAVIOUR OF NORMAL CONCRETE USING GGBS AND ALCCOFINE AS PARTIAL REPLACEMENT TO CEMENT

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ABSTRACT

Concrete is a construction material composed of Cement, Fine Aggregate (Sand), Coarse Aggregate (crushed stone) and Water. Over the last few years, environmental and economical issues related to materials used in construction have stimulated interest in the development of alternative materials and reuse of industrial waste/by-products that can fulfill specifications and also the construction cost is very high by using conventional materials due to unavailability of virgin materials. This problem can be solved by total replacement of concrete with alternative material which is not convenient in terms of required properties. By this limitation of unavailability of material which plays the vital role of concrete we have only choice of partial replacement of concrete ingredients by waste materials, in the present work cement is replaced by 10% GGBS and varying percentage of ALCCOFINE i.e., 5%, 10%, and 15% for M30 grade of concrete.

Keywords*: *Normal concrete, GGBS, Alccofine.

I. INTRODUCTION

The sustainability was a big issue that being concern in making a development. This is because sustainable development has become a key aspect in society, Economics and development. Sustainable development shall meet the needs of the present without compromising ability of future generation to meets their own needs. it also shows that development that going to be made to sustain the planetary resources by using them effectively without making unnecessary wastage. The usage of GGBS and ALCCOFINE to replace the cement, is because the production of the cement emits carbon dioxide gas to atmosphere. The cement industry is held responsible for some of the carbon dioxide emission, because the production of one ton Portland cement emits approximately one ton of carbon dioxide gas into the atmosphere. The emission of carbon dioxide will increase the effect of global warming due to the emission of greenhouse gasses. Among the greenhouse gasses, carbon dioxide contributes about 65% of global warming.

II. MATERIALS USED AND THEIR PROPERTIES

The materials used in the present experimental work are as follows:

2.1 Ordinary Portland Cement (53-grade OPC): The cement consists of preliminary percentage of silicates and some percentage of lime aluminates. On this experiment 53-grade ordinary Portland cement manufacturer Aditya Birla was used for the all mixes. The cement used was contemporary with none lumps.

2.2 Coarse aggregates (IS 383:1970): Locally available crushed granite aggregate which are passing from the IS sieve size of 20 mm and which are retaining in the IS sieve size of 12.5 mm are to be generally used for the construction. The coarse aggregates used were confirming to IS 383:1970. The highest size and grading of the aggregates depends on the special applications.

2.3 Fine aggregates (IS 383:1970): Locally available high quality sand gathered from river bed, that should be pass from IS sieve 4.75mm and the same will be for all of the mixes of concrete. The fine aggregate which is having fineness modulus 2.81 is used were confirming to zone II according to IS code.

2.3 Water: Generally, cement requires about 3/10 of its weight of water for hydration. Water is an important ingredient of concrete as it actively participates in chemical reaction with cement. It also improves the workability. Since it helps to form the strength giving cement gel, the quantity and quality of water required is to be looked carefully. Some specification also accepts water of pH value between 6 and 8 for making concrete but water has to be free from organic matter.

2.4 Alccofine: It is one type of special material which is produced based on the content of slag which almost contain the maximum content of glass which is formed because from the high reactivity and by the granulation process. These materials are formed by the composition of fewer silicates of calcium. The distribution of size of particles will be done based on the ingredients present in it. Due to the accurate procedure of this distribution of particle size this alccofine gives the greater results and reduces the content of water. So alccofine mainly called as a water reducing agent. This may also use up to 70% of replacement in the concrete which replaces the cement. So that Alccofine 1203 is almost used as a water reducer and it will gives the greater workability results.

III. ADVANTAGES AND CHEMICAL COMPOSITION OF ALCCOFINE

Here some of the advantages of Alccofine after partial replace to ordinary concrete, The Table 1 represents the chemical composition of Alccofine and Fig 1 shows Alccofine.

- Durability is improved.
- Strength gain is improved.
- Improves the workability and cohesiveness.
- Better retention of workability.
- Reduces segregation.
- Lowers the heat of hydration.
- Improves the flow ability.
- Many detoriating effects such as corrosion, carbonation and sulphate attack may be minimized or stopped.

Table 1 Chemical composition of Alccofine (%)

CaO	SiO_2	SO_3	Al_2O_3	Fe_2O_3	MgO	Cl
61-64	21-23	2-2.4	5-5.6	3.8-4.4	0.8-1.4	0.03-0.05

Fig 1 Powder form of Alccofine

IV. GROUND GRANULATED BLAST FURNACE SLAG (GGBS)

GGBS is result of steel and iron industries. The main objective of this is to save cement. When the GGBS is use as a replacement of cement the water requirement reduces to obtain the same slump. In the present investigation GGBS is used as a filler material for cement in a constant percentage. GGBS is a cement replacement source however, if the purpose is to enhance some aspect of concrete durability. In general it decreases water demand by 1 to 10%, depending on quantity and due to its surface characteristics and fine quality; it raises pump ability, workability and reduces bleeding of cast concrete. The Table 2 represents Chemical composition for GGBS

Advantages of GGBS are*:*

- It also reduces the heat of hydration
- GGBS is reduction in permeability and increase resistance to chemical attack.
- GGBS is best applicable in the marine structure or concreting in the saline environment.
- It is used for making durable concrete in combination with OPC or POZZOLANIC material
- It includes durability, life span from 50-100
- It reduces damage by sulphate chemicals.

Table 2 Chemical composition for GGBS

No	Constituents	Percentage (%)
1	Fe_2O_3	0.2-0.8
2	MgO	0.5-1.5
3	Na_2O	0.2-0.7
4	K_2O	04.-1

V. HARDENED PROPERTIES TESTS FOR NORMAL CEMENT CONCRETE (NCC)

5.1 Compressive strength test: As per IS 516-1959, Cubes0of size 150 x 150 x 150mm were cast to evaluate the compressive strength of concrete. A test result is the average of at least three standard cured specimen. The maximum strength is at 28 days after curing. The compressive stress calculated in kg/cm^2 from the maximum load sustained by the cube before failure.

Compressive strength (fc) = P/A

Where, P = load at failure in kg and

A = surface area of bearing cube in cm^2

5.2 Flexural strength test: Concrete is weak in tension and strong in compression. Reinforced concrete members, little dependence is placed on the tensile strength of concrete since steel reinforcing bars are provided to resist all tensile forces. As per IS 516-1959,a beam of size 150 x 150 x 700mm is found dependable to measure flexural strength properties of Normal Concrete. Flexural strength expressed as modulus of rapture ff in kg/cm^2 is calculated as:

Modulus of rapture, $f = Pl / (bd^2)$

Where, P is the maximum load at failure in kg, L specimen length in cm, B specimen width in cm and d is the depth of the beam specimen

5.3 Split tensile strength of concrete: The tensile strength is one of the basic and important property of concrete. The concrete is not usually expected to resist the direct tension because of its low tensile strength and brittle nature. However, the determination of of tensile strength of concrete is necessary to determine the load at which the concrete member may crack. The cracking is form of tension failure. The test is conducted as per IS 5816. . For most of the works cylindrical moulds of size 15cm × 30cm are commonly used. This concrete is poured in the mould and tampered properly so as not to have any voids. After 24 hours these moulds are removed and test specimens are put in water for curing. The top surface of these specimen should be made even and smooth. This is done by putting cement paste and spreading smoothly on whole area of specimen. These specimens are tested by compression testing machine after 14 days and 28 days curing.

Split tensile strength = $2p/\pi dl$

VI. RESULTS AND DISCUSSION

6.1 Compressive Strength of NCC

Table 3 Compressive strength of NCC after curing

No	Description	Compressive strength , N/mm^2		
		7days	14days	28days
1	Normal NCC	22.81	25.90	33.62
2	M1+5% MP	23.62	30.81	35.33
3	M2+10% MP	25.18	34.58	39.14
4	M3+15% MP	18.55	26.73	31.02

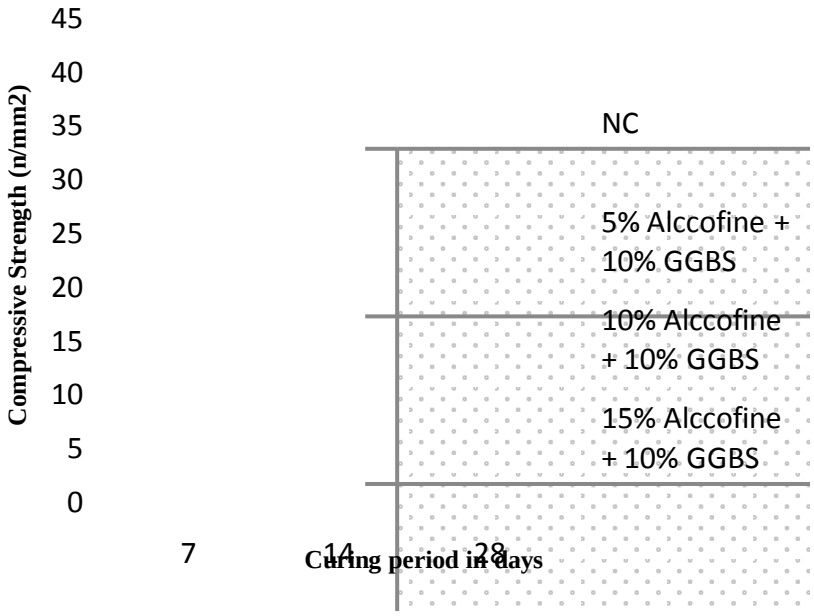

Fig 2 Average Compressive strength of NCC after curing

6.2 Flexural Strength of NCC

Table 4 strength of NCC after curing

No	Description	Flexural strength in N/mm^2 (28Days)
1	Normal NCC	4.06
2	M1+5% MP	4.34
3	M2+10%MP	4.78
4	M3+15% MP	4.70

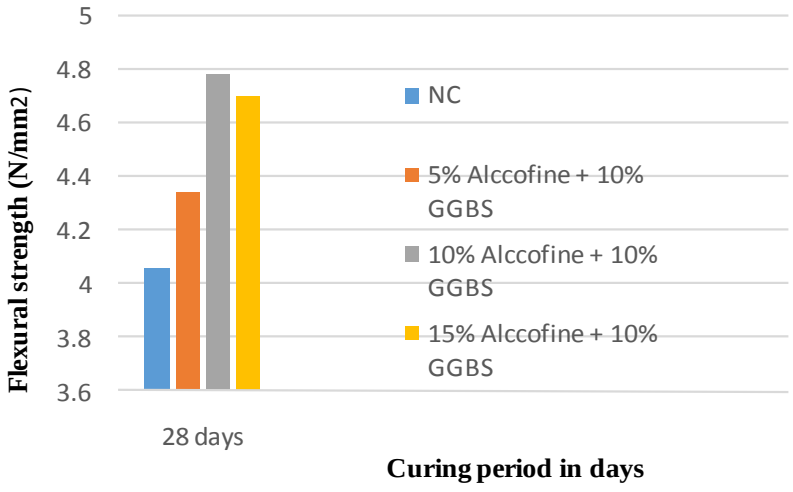

Fig 3 Average Flexural strength of NCC after curing

6.3 Split Tensile Strength of NCC

Table 5 Split Tensile strength of NCC after curing

No	Description	Split tensile strength in N/mm^2	
		14 days	28 days
1	Normal NCC	2.79	3.135
2	M1+5% MP	3.96	4.031
3	M2+10% MP	4.06	4.230
4	M3+15% MP	3.64	3.350

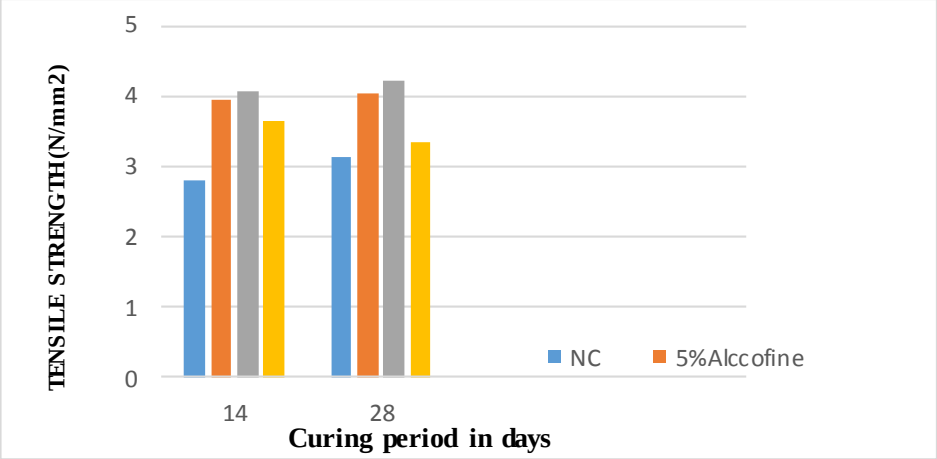

Fig 4 Average split tensile strength of NCC after curing

VII. CONCLUSION

It is observed that there is a gradual increase in the compressive and flexural strength when cement is substituted by ALCCOFINE up to 10%, but further increasing in the percentage of ALCCOFINE results decreases in strength.

- It can to be concluded that if 10% cement is substituted by ALCCOFINE in concrete, it will not only decrease the cost of concrete but at the same time will save large magnitude of cement.
- Variation of compressive strength, tensile strength and flexural strength for the replacement of ALCCOFINE to a level of 5%, 10% and 15% indicate that an optimum replacement level corresponds to 10% in terms of compressive, tensile and flexural strength obtained at 7, 14 and 28 days.
- Alccofine and GGBS was witnessed to improve the mechanical characteristics of concrete.

REFERENCE

[1] M. Shariq, J. Prasad and A.K. Ahuja *department of civil engineering, IIT Roorkee, India*

[2] Pazhani.K. and Jeyaraj.R department of civil engineering, Anna University Chennai India

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[4] Rajeshree, Kavitha.s Assistant Professor, ACS College of Engineering, Kambipura Bangalore, Karnataka,

[5] Shetty M.S., 'Concrete technology', S. Chand publishers, 7th revised edition 2013.

[6] IS:2386-1963 Part I to VIII, "Indian standard methods of test for aggregate for concrete", Bureau Indian standards, New Delhi, India.

[7] IS: 383-1970, "Specification for coarse and fine aggregates from natural sources for concrete (2nd revision)", Indian standards bureau, New Delhi, India

[8] IS : 3812-2003, "Specification for fly ash for use as pozzolona & admixture".

[9] IS: 8112-1989, "Specification for 43 grade ordinary Portland cement (1st revision)", Indian standards bureau, New Delhi, India.

[10] IS: 516-1959, "Methods of tests for strength of concrete", Indian standards bureau, New Delhi, India

[11] IS: 456-2000, "Plain and reinforced concrete code of practice", Indian standards bureau, New Delhi, India.

[12] IS: 10262-2009"Recommended guidelines for concrete mix design", Indian standards bureau, New Delhi, India.