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IMPROVEMENT AND EXAMINE THE BEHAVIOR OF CONVENTIONAL AND HIGH STRENGTH SELF- COMPACTINGMORTAR MIXES

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Abstract: The aim of this work is to examine the rheological and strength properties of self- compacting mortar (SCM) mixes containing waste industrial by products such as ground granulated blast furniture slag (GGBS) and micro silica fume as a cement substitute (MS).Furthermore, GGBS replacement ranges from 10% to 70%, with MS additive constant at 10% by cement weight. The usage of pozzolanic materials in mortar has shown to improve certain properties like rheology of concrete, setting time, and compressive strength. Of concrete Resulting in a performance-based specification SCM mixes in various combinationsis the most effective approach. Different test are conducted in the lab like Slump flow, V- funnel time, with different mixes made in the lab with and without varying percentages of industrial by-products were compared, and performance was calculated.

Keywords: Conventional mortar, Self-compacting mortar (SCM), Rheology, and compressive strength. Granulated blast furniture slag (GGBS), Micro silica fume (MS).

1. INTRODUCTION

The most popular binding material used in civil engineering projects is ordinary Portland cement. Self-Compacting concrete is a relatively new concrete technology concept that was discovered in 1986 by Japanese researchers as a way to increase the efficiency of concrete by increasing the powder content and which helps in the process of construction practice It is also important to achieve an optimal SCC or SCM mix design.

1.1 Cement mortar: Cement Mortar is a paste made up of cement, sand, and water that is homogeneous. By combining different proportions of cement and sand, various cement mortars can be made. Cement and sand are correctly combined in a dry state to make cement mortar. The water is then gradually applied and combined with a scoop. Clay and other impurities should be removed from the water.

1.2 Self-Compacting mortar: The main purpose of this study is to learn more about the chemical and mechanical properties of SCM., which is also known as "highly flowable, stable concrete and mortar, which is easily sustainable and can fill the formwork without the need for any integration or significant separation.

1.3 Objectives of the Present Investigation:

Main objectives derived based on the literature review areas listed below.

1. Different trials of self-compacting concrete mixes are developed in the lab

2. The rheological and hardened properties of conventional concrete and SCM mixes concrete were investigated in the laboratory.

2. METHODOLOGY

The procedure will be divided into two steps. In the first stage, the compressive strength of samples made from mortar composites was measured after seven and twenty eight days of water curing, and in the second stage, the new mortar flow diameter and V-funnel flow time were determined. The SCM compounds' dry unit weight was also calculated... For these experiments, the standard mortar mixes and eight SCM mixes, together about 48 Specimens, are casted in the laboratory. The Fresh and Harden Properties of the two mix combinations havebeen tested in the lab and are published

Materials Properties

2.1.1 Ordinary Portland cement: The cement used is Portland cement(Ramco) in 43 grades that comply with IS: 269-2015.

2.1.2 Ground granulated blast furnace slag [GGBS]: is a cementitious substance that is primarily used in concrete and is a by-product of the iron-making blast furnaces.

2.1.3 Micro Silica fume[MS]: Silica fume, also known as micro silica or condensed silica fume, is another substance used as an artificial pozzolanic admixture, with a specific surface area of about 20,000m2/Kg, compared to 230 to 300 m2/Kg for cement..

2.1.4 M Sand: It is used good manufacture sand that is free of earthy and organic matter and conforms to IS: 383-2016 Defined as Zone-II. The physical properties of the various materials used in this study are described in Table-1. It is used good manufacture sand that is free of earthy and organic matter and conforms to IS: 383-2016 Defined as Zone-II. The physical properties of the various materials used in this study are described in Table-1.

2.1.5 Super plasticizers: The super plasticizers Mater glenium sky 8233, a FOSROC Company product with a specific gravity of 1.222, were used in this project..

2.1.6 Viscosity modifying agents: In this project, the VMA GLENIUM B223 will be used. The VMA contributes to a high level of homogeneity and reduces the chances of segregation.

2.1.7 Water-powder ratio: The weight of water in the mix over the weight of cement may have an effect on mortar strength. The water powder (w/p) ratio used in this study is between 0.30-0.35.

Table-1: Physical Properties of Materials

Materials	Tests Conducted	Results	As per IS-Code Requirements
Cement	Specific gravity	2.95	3.15
	Fineness (%)	9.0	10
	Normal consistency (%)	30	-
	Initial setting time (minutes)	35	Not less than30
	Final setting time (minutes)	346	Not more than 600
	Compressive Strength (Mpa)		
	7- days	26.20	25.80
	28-days	43.00	45.00
GGBS	Specific gravity	2.85	-
	Fineness (%)	390	275
Micro Silica flume	Specific gravity	2.16	-
Fine aggregate	Specific gravity	2.67	2.75
	Fineness modulus	2.30	3.20
	Bulk Density (Kg/m^3)	1150	1250

2.2. Mixture proportions: In this analysis, the rheology and hardened properties of traditional concrete and SCM mixes with partial cement replacement with additive by GGBS and MS withvarying percent form 10% to 70% and keeping 10% constant were conducted. The control mix is made up entirely of OPC and standard M sand, with no substitutions. A total of eight mortar mix proportions with water/powder ratios ranging from 0.30 to 0.35 were produced. Thelaboratory results will produce a mix proportion that included two types of mixes, with and without mix substitution, traditional mortar mix and self-compacting mortar mix

2.3. Normal Mortar Mix: To check the compressive strength of cement mortar cubes with a cement-to-sand ratio about 1:3 and a water content of (P/4+3.0) percent of the total weight of cement plus sand is used, normal mortar cubes are first cast.

2.4. Self-Compacting Mortar Mix: The main purpose of this study is to determine the rheological and strength properties of SCM mixes with and without FA or SF.

The results of two basic tests, according to EFNARC guidelines: the mini-slump cone test and the mini V-funnel test (2005) are used to measure the rheological properties of SCM mixes. The flow properties of different trial mixes with various proportions of cement, FA, and SF, with sufficient doses of SP and VMA, are calcualted. The procedure is repeated until the trial mix has the correct flow characteristics. With an FA of 10-30% and an SF of 5–15 percent, the characteristics of SCM mixes are investigated further. At different ages, the rheological and strength properties of the formed mixes are measured

(i) Mini Slump Cone Test: The results from the mortar flow test are used to assess the flow capacity of the mortar mix. At 2 minutes after raising the cone, the spread diameter is measured. According to EFNARC guidelines, the spread diameter should be between 240 and 260 mm (2005).

(ii) Mini V-funnel test: The mortar mini V- funnel test is used to determine he mortar mixture's viscosity. According to EFNARC guidelines, the optimal flow period for SCM Should is between 7 and 11 seconds (2005).

2.5. Laboratory Production of Self-Compacting Mortar Mixes::

Table-2 shows the rheological properties of the SCM mix that were obtained. In all of the mixes, the total quantity of ingredients (cement and sand) and the quantities needed to achieve the desired SCM mix are held at 800 g. The w/p ratio, which ranges between 0.35 and 0.9 according to EFNARC guidelines, Slump cone and V-funnel studies are influenced by this factor.

Initial trials revealed bleeding, segregation, and inconsistency, indicating that the product did not meet the expected criteria. The weight of powder, w/p ratio, SP, and VMA constituent are all adjusted simultaneously during each trial without bleeding or segregation to achieve the desired homogeneous and consistent mix, as shown in Table-2.

3.0. RESULTS AND DISCUSSION

Tables and graphs are used to present the effects of rheological and strength properties calculations for different mixes. Table-2 The rheological properties obtained by varying the SP and VMA dosages are summarized in this paper. In addition, the hardened properties of mixes, such as compressive strength and density, are tested with different levels of GGBSand MS replacement.in the table-3

Table- 2: Fresh properties of SCM mix

Figures	Mix notations	w/p ratio	Slump flow(mm) mm)	V-funnel time (S)	SP (%)
	Nominal mix	0.35	270	11.90	1.2
	10%MS +10%GGBS	0.35	250	10.40	1.2
	10%MS +20%GGBS	0.35	265	10.90	1.2
	10%MS +30%GGBS	0.35	270	11.00	1.2
	10%MS +40%GGBS	0.35	270	11.05	1.2
	10%MS +50%GGBS	0.35	275	11.00	1.2
	10%MS +60%GGBS	0.35	260	10.50	1.2
	10%MS +70%GGBS	0.35	270	11.10	1.2

Table 3: Conventional and SCM Mixes Compressive Strength

Mix Design specifications	Compressive strength (Mpa)			Density(Kg/m^3)		
	7-days	28- days	91-days	7- days	28- days	91-days
Nominal mix	20.10	45.00	48.00	2345	2565	2640
10%MS +10%GGBS	22.30	48.05	49.50	2295	2310	2350
10%MS +20%GGBS	25.70	49.70	51.20	2235	2250	2265
10%MS +30%GGBS	30.70	51.50	52.50	2230	2245	2270
10%MS +40%GGBS	31.05	53.15	55.30	2215	2240	2250
10%MS +50%GGBS	37.75	59.67	62.25	2295	2340	2355
10%MS +60%GGBS	34.60	57.20	60.25	2300	2345	2350
10%MS +70%GGBS	33.20	55.30	58.40	2190	2235	2255

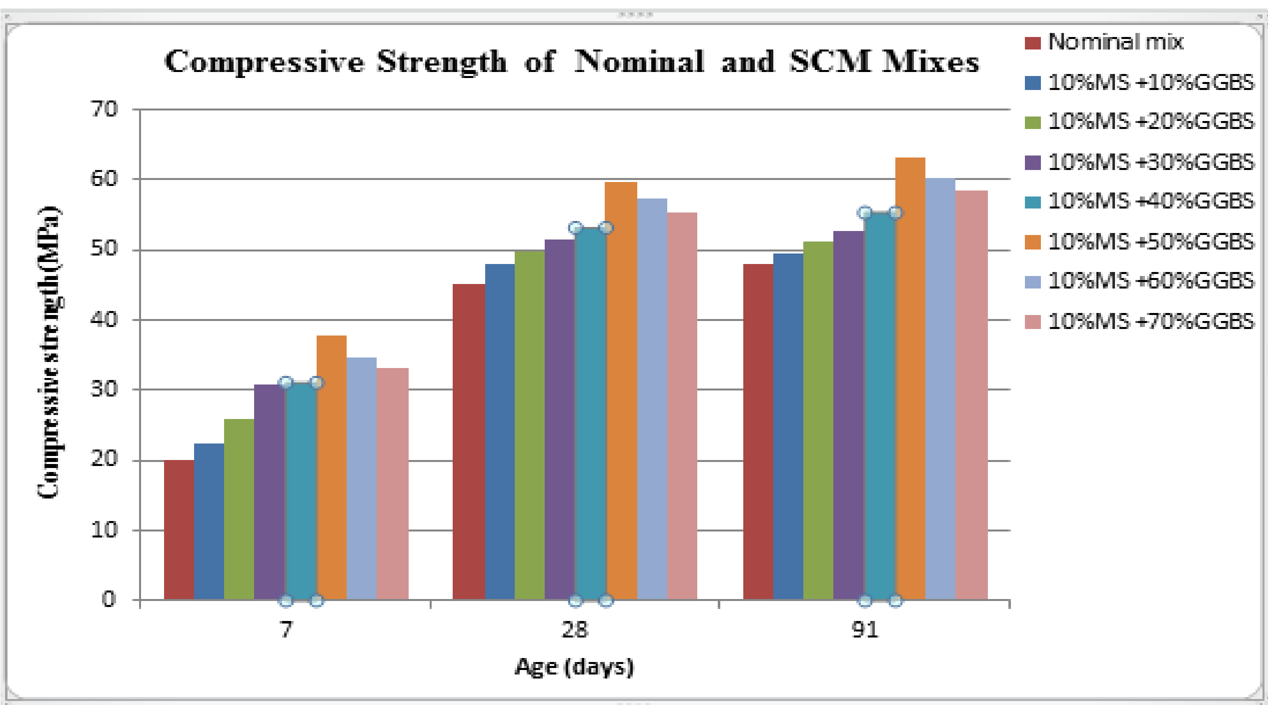

Fig 1:- AGE VERSUS compressive strength of SCM mixes.

Interpretations: From **Fig. 1,** Control SCM mixes were compared to GGBS and MS-based mixes with GGBS and MS alternative levels by weight of cement, respectively. Further replacement levels of GGBS and MS in the ranges of 10-70% and 10% constant for various ages are presented in the form of bar charts. As a result, compressive strength variation is lower in Nominal mixes and slightly higher in GGBS and MS-based mixes in all situations. Also, it is noted that there is a marginally increase in strength at higher ages than compared to lower ages.

Discussion of the findings:

The following are a few main findings based on experimental tests..

(i) When SP and VMA dosages were applied to SCM mixes with GGBS and MS- based mixes during the development process, the rheology was not substantially different from that of the intended SCM mix

(ii) As MS is applied to SCM mixes, the compressive strength increases, and this istrue even in composite mixes, but the compressive strength shows a clear downward trend at all mix.

(iii) In GGBS-based mixes, the compressive strength of SCM mixes increases, but there is also an increasing trend in comparison.

(iv) The strength of mixes is observed to increase with age at all ages due to laterpozzolanic action.

CONCLUSIONS:

The few important conclusions that arrive based on results are listed below.

- SCM combinations can be created by substituting GGBS and MS with appropriate SP and VMA dosages.
- The results show that increasing the compressive strength requires a certain percentage of MS addition. However, it appears that GGBS can substitute for cement up to 70% of the time without sacrificing the strength
- SCM mixes with good flow characteristics and better compressive strength can be achieved using MS as a cement replacement standard of 10 percent constant. However, the results show that in all conditions, a percentage addition of GGBS and MS of up to50% can be achieved without compromising compressive strength.
- While GGBS and MS-based mixes are compared to nominal mixes, the density of mortar cubes obtained is higher.

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