BEHAVIOR OF BLENDED SELF-COMPACTING CONCRETE USING INDUSTRIAL BYPRODUCT

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Abstract- Advancement in technology demand certain properties of the concrete related to strength and durability to be improved to some extent possible. In this regard, self-compacting concrete was emerged to overcome certain fresh properties also.. The SCC was first developed in 1988 to achieve workable and durable concrete structure. In the present article summarizes the improvement in certain fresh properties even with mechanical properties was found to be improved with metakaolin and silica fume as admixtures at different ages of concrete curing.

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***Index Terms*-** SCC- self compacting concrete, MK- Metakaolin and SF- Silicafume

I. INTRODUCTION

The development of self-compacting concrete (SCC) has been one of the most important development in the building industry. The purpose of this concrete concept is to decrease the risk due to human factor. Also with an addition of admixtures, great improvement in the pore structures, also compact ability was found to be affected by the characteristics of the materials and the mix proportions hence, it is necessary to arrive the proper mix design procedure. The use of SCC is spreading worldwide because of its very attractive properties.SCC was first developed in the late 1980's by Japan researchers. Research & development work into SCC in Europe began in 1990's. In Europe it was probably first used in civil work for transportation networks in mid 1990's.The EC funded a multi-national industry lead project "SCC" 1997-2000 & since then SCC has increasing in all European countries. In 2002 EFANARC published their "specification guidelines for SCC Okamura & Ozawa have proposed the mix proportion system for SCC.

II. IDENTIFY, RESEARCH AND COLLECT IDEA

CHANDRAKANT U.et.al (2014) studied was made an attempt to understand the effect of mineral admixtures on fresh and hardened properties of SCC. In this study, metakaolin and cement kiln dust were considered as mineral admixtures. The addition of 10 % Kiln Dust in SCC mixes found to increase the self compact ability characteristic like filling ability, passing ability, flowing ability and segregation resistance. The compressive strength, flexural strength and split tensile strength of SCC increased for 7 days to 28 days of replacement levels of 10%, 20%, 30 % of cement by Metakaolin & CKD.

B.H.V. PAI et.al (2014) studied on Self Compacting Concrete mixes Ash and Rice Husk Ash. The research project was aimed at producing and comparing SCCs incorporating Fly ash (FA) and Rice husk ash (RHA) as supplementary cementing materials in terms of their strength parameters. SCC containing FA has better performance in regard of strength parameter than SCC containing RHA. It was also observed from the experimental results that the calculated cement content (200kg/m3) as per the Nan Su et al. method was not adequate to give the required strength to the mix.

J.M.SRISHAILA et.al (2014) studied on Combined Effect of Ground Granulated Blast Furnace Slag and Metakaolin on Mechanical Properties of Self Compacting Concrete, investigated the combined effect of Ground Granulated Blast Furnace Slag (GGBS) and Metakaolin on the properties of self compacting concrete. The workability test of self compacting concrete was carried out on fresh concrete. The compressive, split tensile, and flexural strength test of concrete with replaced GGBS plus Metakaolin at 5%,15%and

25% and 3%,6% and 9% were examined after curing period of 28 and 56 days. Fresh property results show that as the percentage of Metakaolin increases the filling and flowing ability of the concrete decreases. The compressive, split tensile, flexural strength was maximum for the mix proportion Metakaolin 6% and GGBS 15% and is higher by 44% with respect to first mix.

J.M.SRISHAILA et.al (2014) investigated on mechanical properties of self compacting concrete incorporating combined effect of GGBFS at 5%, 15% & 25% and metakaolin at 3%, 6% & 9%. Fresh properties like filling and flowing ability were found to be decreased with the percentage increase in metakaolin. The hardened properties showed maximum strength at 6% of metakaolin replacement and 15% of replacement of GGBFS.

B.H.VENKATARAM et.al (2014) studied on self compacting concrete by incorporating the effect of admixtures. Author aimed at producing SCC mixes of M25 grade by considering the effect of five mineral admixtures namely, fly ash, GGBFS, silica fume, rice husk ash and shell lime powder. Also hardened properties of these SCC mixes were compared in terms of strength.

DEEPA BALAKRISHNAN S.et.al (2013) studied on fresh properties and strength parameters of SCC incorporating fly ash and dolomite powder. High volume fly ash self compacting concrete was developed with 18.75%, 25% & 31.5% by percentage mass replacement of fly ash and 6.25%, 12.5% of replacement with dolomite powder. From the experimental results, it was found that, inclusion of fly ash in SCC mixes tend to reduce the bleeding and segregation and passing and filling ability of concrete was found to be increased. Dolomite powder found to improve the segregation resistance of the concrete mix.

III. WRITE DOWN YOUR STUDIES AND FINDINGS

The Present investigation methodology adopted has been divided into two phase. The 1st phase's covers the development of SCC mixes using industrial by product such as SF and MK and also study the fresh properties of developed blended SCC mixes in the laboratory. The 2nd phase covers the study of hardened properties of developed SCC mixes in the laboratory according to Indian scenario.

Cement: In this experimental study, ordinary Portland cement 43 grade conforming to IS: 8112-1989.
Fine aggregate: Locally available river sand nearby area was used as a fine aggregate.
Coarse aggregate: All types of aggregates are suitable. The normal adopted size is ranged 10-12mm.

Table 1 Physical Properties of Coarse and Fine Aggregates

Property	Fine aggregate	Coarse aggregate
Specific gravity	2.66	2.67
Finess modulus	2.32	7.69
Bulk density	1297	1327
Particle shape	Rounded	Angular

Fresh properties

Filling Ability: The ability of concrete to fill up the formwork to be placed.

Passing Ability: The ability to pass through congested reinforcement without separation of the constituents or blocking.

Resistance to segregation: The ability to retain the coarse components of the mix in suspension in order to maintain a homogeneous material.

Table 2 Fresh properties of Self Compacting Concrete.

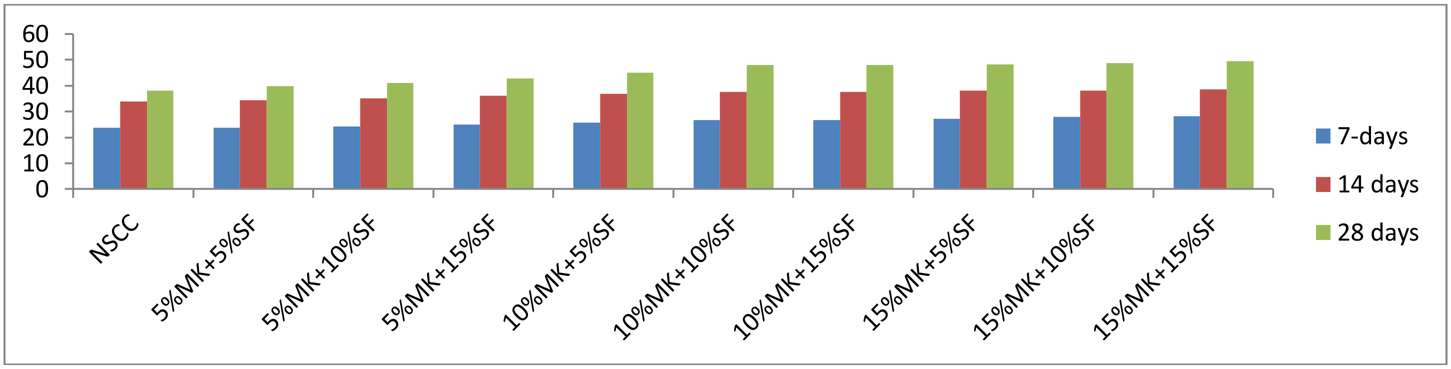
MIXES	Slump flow (650-800mm)	T_{50cm} Slump flow (2-5sec)	V-funnel (6-12sec)	J-ring (0-10sec)
NSCC	710	3.46	8	4
5%MK+5%SF	706	3.34	9	7
5%MK+10%SF	702	3.12	9	5
5%MK+15%SF	700	3.04	10	6
10%MK+5%SF	696	2.97	10	7
10%MK+10%SF	689	2.90	11	8
10%MK+15%SF	682	2.82	12	9
15%MK+5%SF	670	3.46	8	7
15%MK+10%SF	687	3.34	10	4
15%MK+15%SF	690	3.12	9	5

Hardened properties of SCC

The following are the tables give the test results of Self compacting concrete, when cement is partially replaced by Silica fume and metakaolin, for Compressive and Split tensile strength.

Table 3 Compressive Strength test results

Specification	7-days compressive strength(Mpa)	14-days compressive strength(Mpa)	28- days compressive strength (Mpa)
NSCC	23.63	33.82	**38.06**
5%MK+5%SF	23.77	34.24	39.76
5%MK+10%SF	24.18	35.08	41.09
5%MK+15%SF	24.92	36.10	42.72
10%MK+5%SF	25.6	36.90	44.89
10%MK+10%SF	26.6	37.58	47.92
10%MK+15%SF	26.7	37.65	47.94
15%MK+5%SF	27.2	37.98	48.23
15%MK+10%SF	27.89	38.05	48.74
15%MK+15%SF	28.24	38.50	49.35

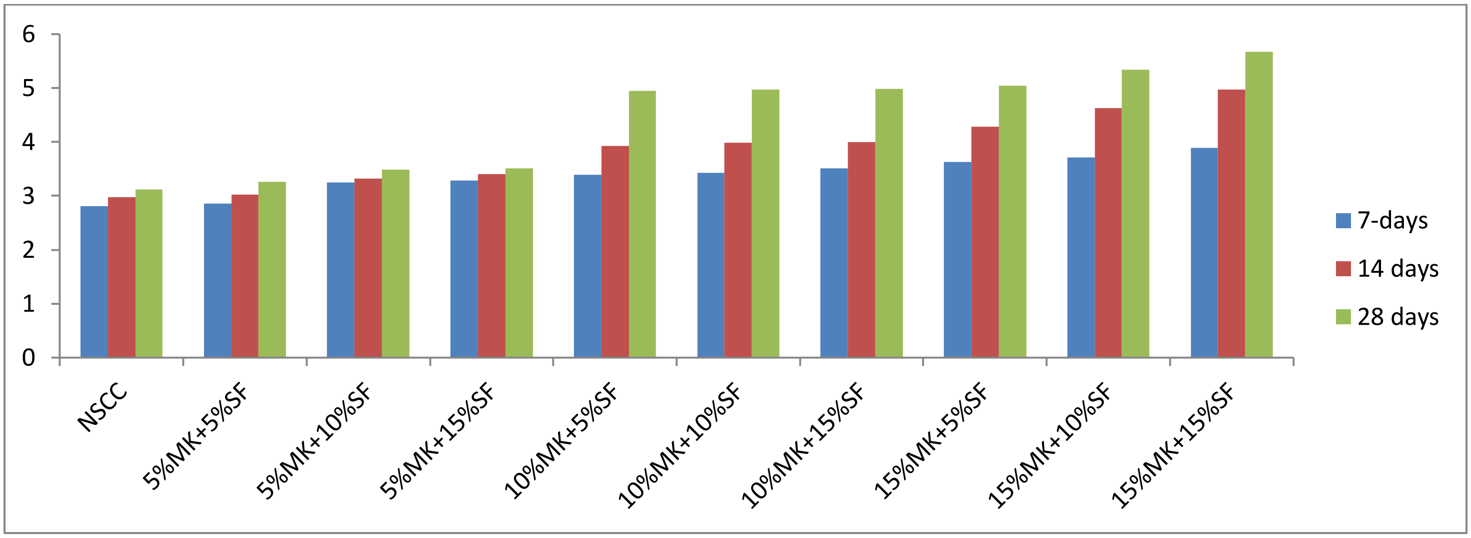


Graph 1 Compressive strength results

The above graphical representation indicates the compressive strength for 7, 14 and 28 days with various replacements of MK & SF with cement. It has been noted that increase in the percentages and blending of both the mineral admixtures gives the incremental strength.

Table no 4: Split tensile strength test results

Specification	7-days Split tensile strength(Mpa)	14-days Split tensile strength(Mpa)	28- days Split tensile strength (Mpa)
NSCC	**2.81**	**2.98**	**3.12**
5%MK+5%SF	2.85	3.02	3.26
5%MK+10%SF	3.25	3.32	3.48
5%MK+15%SF	3.28	3.40	3.51
10%MK+5%SF	3.39	3.92	4.94
10%MK+10%SF	3.42	3.98	4.97
10%MK+15%SF	3.51	4.00	4.98
15%MK+5%SF	3.63	4.28	5.04
15%MK+10%SF	3.71	4.62	5.34
15%MK+15%SF	3.89	4.97	5.67



Graph 2 Split tensile strength

The above graphical representation indicates the splitting tensile strength for 7, 14 and 28 days with various replacements of MK & SF with cement. It has been noted that increase in the percentages and blending of both the mineral admixtures gives the incremental strength.

CONCLUSION

Trial and error procedure have to be adopted for maintaining flow ability, self compatibility and obstruction clearance as per Nan Su method till to arrive consistent SCC mix.

There was an increase in the strength of SCC when the cement is replaced by MK & SF up to 15%. This also reduces the cement content by increasing the MK &SF thus reducing the further cost of SCC mixes developed.

Using the combined mixing of SF & MK as a cement replacement level between 5-15%, SCC mixes can be achieved with good flow characteristics and better compressive strength. However the results obtained proves that percentage addition of SF& MK is allowed up to 15% without sacrificing the compressive strength in all the cases.

MK & SF can be very good replacement for cement with respect to economy, strength and the considerations of availability of resources.

The MK & SF in place of cement shall be very economical and can also help in the utility of Industrial wastes and in maintaining the ecological balance, thus reducing the consumption of cement.

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