EFFECT OF WOLLASTONITE POWDER IN SELF COMPACTING CONCRETE

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ABSTRACT

The use of additive material such as silica-fume, fly ash, GGBS, micro-silica etc. in self compacting concrete is now a days very vital for purpose of research. A Concrete which doesn't require compaction or vibration to settle down is termed as self compacting concrete means which is compacted by its own weight. Self compacting concrete is used for concreting in congested area where normal concrete can't reach. Wollastonite (calcium meta-silicate) is a natural material that consists of calcium silica oxides. This research program focused on evaluating the feasibility of using wollastonite in concrete or mortar. The experimental program for this study is designed to investigate the fresh properties and strength contribution for mortar cubes with wollastonite at 0% to 25% replacement with ordinary Portland cement. Study lead us to replace wollastonite powder at different percentage (0%, 5%, 10%, 15%, 20%, and 25%) and fly ash of constant percentage (10% and 20%) with cement and will be studied for workability, compressive strength, tensile strength and flexure strength. So here in this project, it has been used as replacement of cement by different percentage of wollastonite powder and constant contain of fly ash (10% and 20%) for making self compacting concrete. The percentage replacement of wollastonite powder will be 0%, 5%, 10%, 15%, 20%, and 25% with ordinary Portland cement. Cement has been used in making SCC with super plasticizer as an admixture to get proper workability and for getting strength of concrete. Cubes, beams and cylinders will be casted and tested for slump, compressive strength, splitting tensile strength before that for acceptance criteria of slump flow test, V-funnel, L-box test, U-box test are presented.

Keyword : - *Wollastonite powder, fly ash, self compacting concrete, Workability, Compressive strength, Tensile strength, Flexural strength.*

1. INTRODUCTION

The concrete has been the best building material for all types of industrial and civil engineering buildings. Increment in the involution of construction and lack of trained construction labors. In congested design of reinforcement make difficult to reach concrete at each and every corner in case of normal concrete. So self compacting concrete, with various additive materials allows us to overcome over problem of reaching concrete in each and every corner of reinforcement. Development of Self-compacting concrete (SCC) is considered as the most sought development in the construction industry due to its numerous inherited benefits.

Various additive material have been used till today for making self compacting concrete such as fly ash, GGBS, micro silica, silica fume etc. But for wollastonite, no that much investigation has been done yet. In this project we emphasis on effect of wollastonite powder in self compacting concrete by replacing it with cement.

2. OBJECTIVES

- To make control mix of self compacting concrete with constituent materials without wollastonite.
- To examine the fresh properties of concrete by using various test methods of efnarc guideline such as passing ability, filling ability, segregation resistance.
- To evaluate the fresh properties (Passing ability, filling ability and segregation resistance) of SCC with use of wollastonite powder 0% ,5%,10% ,15% ,20%,25% and fly Ash 10% and 20% replaced by binder material respectively.
- To evaluate the harden properties (compressive strength ,Split tensile Strength and Flexural test) of SCC with use of wollastonite powder 0% ,5%,10% ,15% ,20%,25% and fly Ash 10%and 20% replaced by binder material.

3. MATERIALS

3.1 Cement: Ordinary Portland cement 53 grade confirming I.S.12269-1987 is used.
3.2 Fine aggregates: The fine aggregate used in the investigation is clean river sand and conforming to zone II. The sand was first sieved through 4.75mm sieve to remove any particles greater than 4.75mm. Fine aggregates shall conform to the required of IS 383.
3.3 Coarse aggregates: The coarse aggregate used in the investigation is crushed stone aggregate passing through 12.5mm sieve and retain on 10mm sieve. Coarse aggregate shall comply with the requirement of IS 383.
3.4 Fly ash: Fly ash is a fine inorganic material with pozzolanic properties, which can be added to SCC to improve its properties. However the dimensional stability may be affected and should be checked. Class F fly ash which satisfies IS 3812 obtained from Gandhinagar thermal power station was used for production of Self compacting concrete.
3.5 Wollastonite powder: Wollastonite powder is a naturally occurring mineral which came from Rajasthan mines which has specific gravity 2.87. Generally it is known as calcium Meta silicate (CaSio3).

Chemical Test result of Wollastonite Powder		
Sr. No.	**Test Name**	**Test Result**
1	CaO	47.89%
2	SiO2	48.7%
3	Fe2O3	0.33%
4	Al2O3	0.35%
5	MgO	0.22%
6	Na2O	0.02%
7	K2O	0.10%
8	TiO2	0.06%
9	Loss on Ignition	1.68%
10	Sp. Gravity	2.87

3.6 Super plasticizer: Glenium sky 8784 with viscosity modifying agent is used confirming to IS 9103.
3.7 Water: Water conforming to Standards should be used in SCC mixes. Where recycled water, recovered from processes in the concrete industry is used but should confirm the specifications.

4. MIX-DESIGN

4.1 M-40 GRADE OF CONCRETE

Sr. No.	Type of Mix	W/P ratio	Total Binder (kg/cum)	Cement (kg/cum)	Fly ash (kg/cum)	Wollastonite powder (kg/cum)	Coarse aggregate (kg/cum)	Fine aggregate (kg/cum)	Water (ltr/cum)	S.P.(1%) (kg/cum)
1	MIX-1 (0% WP+ 10% FA)	0.36	528	475.2	52.8	0	803	872	190	5.28
2	MIX-2 (5% WP+ 10% FA)	0.36	528	451.35	52.8	23.85	803	872	190	5.28
3	MIX-3 (10% WP+ 10% FA)	0.36	528	427.5	52.8	47.7	803	872	190	5.28
4	MIX-4 (15% WP+ 10% FA)	0.36	528	403.65	52.8	71.55	803	872	190	5.28
5	MIX-5 (20% WP+ 10% FA)	0.36	528	379.8	52.8	95.4	803	872	190	5.28
6	MIX-6 (25% WP+ 10% FA)	0.36	528	343.2	52.8	132	803	872	190	5.28

4.2 M-30 GRADE OF CONCRETE

Sr. No.	Type of Mix	W/P ratio	Total Binder (kg/cum)	Cement (kg/cum)	Fly ash (kg/cum)	Wollastonite powder (kg/cum)	Coarse aggregate (kg/cum)	Fine aggregate (kg/cum)	Water (ltr/cum)	S.P.(1%) (kg/cum)
1	MIX-1 (0% WP+ 20% FA)	0.36	528	422.4	105.6	0	803	872	190	5.28
2	MIX-2 (5% WP+ 20% FA)	0.36	528	398.55	105.6	23.85	803	872	190	5.28
3	MIX-3 (10% WP+ 20% FA)	0.36	528	374.7	105.6	47.7	803	872	190	5.28
4	MIX-4 (15% WP+ 20% FA)	0.36	528	350.85	105.6	71.55	803	872	190	5.28
5	MIX-5 (20% WP+ 20% FA)	0.36	528	327	105.6	95.4	803	872	190	5.28
6	MIX-6 (25% WP+ 20% FA)	0.36	528	290.4	105.6	132	803	872	190	5.28

5. RESULTS OF FRESH PROPERTY OF M-40 AND M-30 GRADE OF CONCRETE

Sr. No.	Type of Mix	M-40				M-30			
		Slump (mm)	V-Funnel (sec)	L- Box (h2/h1)	U-Box (mm)	Slump (mm)	V-Funnel (sec)	L- Box (h2/h1)	U-Box (mm)
		650-800 mm	8-12 sec.	0.8-1	0 to 30mm	650-800 mm	8-12 sec.	0.8-1	0 to 30mm
1	MIX-1	655	11	0.82	29	690	11.2	0.86	26
2	MIX-2	670	10.8	0.87	27	705	10.6	0.88	24
3	MIX-3	690	10.5	0.89	24	720	9.3	0.90	21
4	MIX-4	720	9.6	0.9	22	725	8.9	0.92	20
5	MIX-5	730	9.1	0.93	20	730	8.8	0.94	18
6	MIX-6	760	8.8	0.94	18	745	8.2	0.97	17

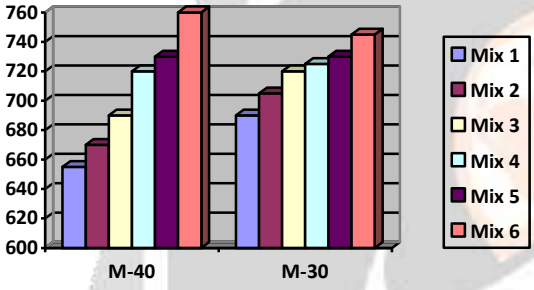

Fig 5.1: Slump flow test

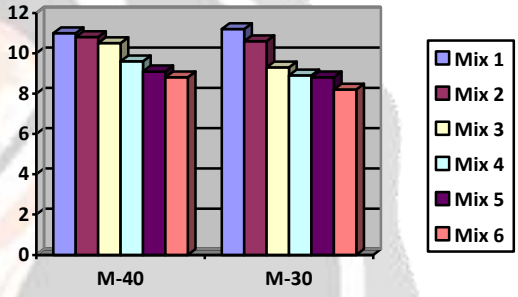

Fig 5.2: V-funnel test

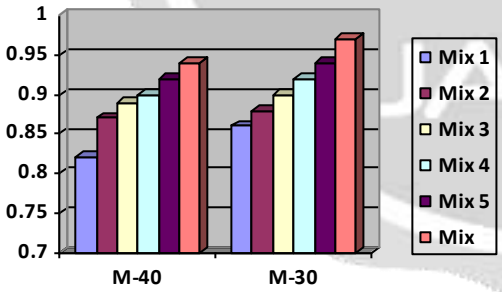

Fig 5.3: L - Box test

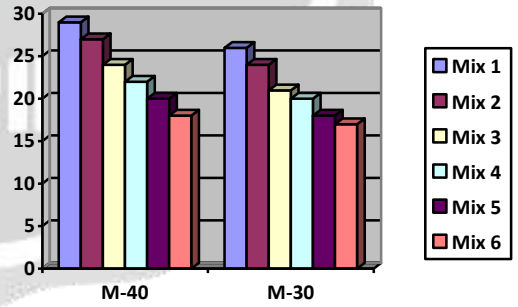

Fig 5.4: U - Box test

6. RESULTS OF HARDENED PROPERTY OF M-40 AND M-30 GRADE OF CONCRET

6.1 Compressive strength

Compressive Strength of cubes in MPa							
Sr.No.	Type Of Mixes	M-40			M-30		
		7 days	14 days	28 days	7 days	14 days	28 days
1	Mix-1	37.78	47.38	58.67	28.74	35.63	43.78
2	Mix-2	37.07	45.86	56.09	27.26	33.62	41.4
3	Mix-3	35.90	42.84	53.15	25.7	31.4	38.59
4	Mix-4	32.80	40.70	50.84	23.7	28.81	36.3
5	Mix-5	30.76	37.78	47.64	22.52	27.33	33.7
6	Mix-6	29.24	36.89	44.80	20.59	25.62	31.18

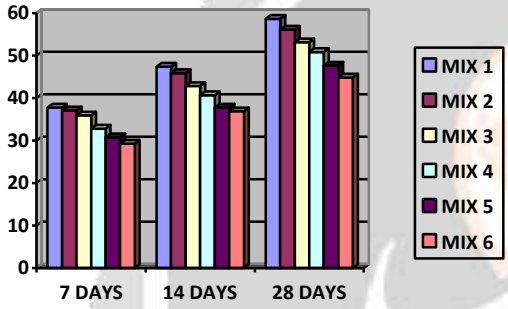

Fig 6.1: M-40 Grade Compressive strength

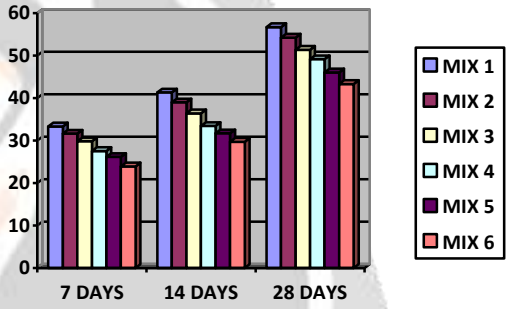

Fig 6.2: M-30 Grade Compressive strength

6.2 Flexural Strength & Tensile Strength

Sr.No.	Type Of Mixes	Flexural Strength(Mpa)		Tensile strength(Mpa)	
		M-40	M-30	M-40	M-30
		28 days	28 days	28 days	28 days
1	Mix-1	5.84	4.26	5.62	3.85
2	Mix-2	5.47	4.00	5.01	3.38
3	Mix-3	5.05	3.65	4.71	3.06
4	Mix-4	4.72	3.36	3.84	2.78
5	Mix-5	4.32	3.08	3.56	2.38
6	Mix-6	3.98	2.73	3.42	1.87

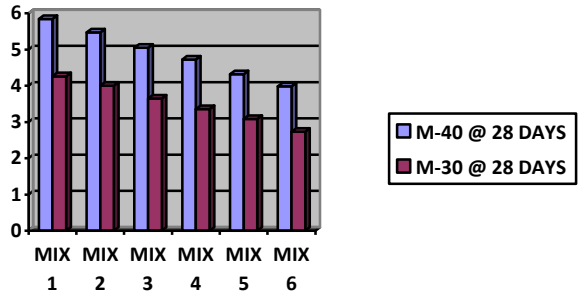

Fig 6.1(a): Flexural test

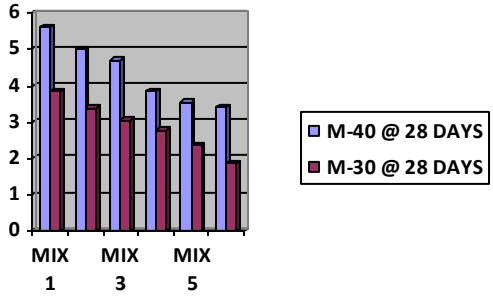

Fig 6.2(b): Tensile strength test

7. CONCLUSIONS

Fresh property

- Till today we have achieved acceptance criteria for being self compacted concrtete of M-40 and M-30 grade.
- In Slump flow test, The result shows that if wollastonite powder will be increase upto 5% in each stage slump flow variation will be 2.29%,5.34%, 9.92%, 11.4%, 16.3% for M-40 respectively and 2.17%, 4.35%, 5.07%, 5.8%, 7.97% respectively for M-30 grade of concrete .
- In V-funnel test, The result shows that if wollastonite powder increase 5% in each stage time variation will be -1.818%, -4.545%, -12.72%, -17.27%, -20% respectively for M-40 and -5.357%, -16.964%, -20.53%, -21.42%, -26.785 respectively for M-30.
- In L-box, variation will be 6.09%, 8.53%, 9.76%, 13.41%, 14.63% respectively for M40 and 2.32%, 4.65%, 6.97%, 9.3%, 12.79% respectively for M30.
- In U-box, variation in % will be -6.89%, -17.24%, -24.13%, -31.03%,-37.93% for M40 and -7.69%, -19.23%, -23.07%, -30.76%, -34.61% respectively for M30.

Hardened property

- The Use of wollastonite powder and fly ash by substitution to binder has no negative effect of workability of SCC.
- First of all trials have been done for achieving S.c.c by using efnarc guideline and tested so we got M40 grade concrete and then by terminating 10 % of flyash we got M30 grade.
- All cubes, beams and cylinder have been tested after proper curing with normal water.
- Curing was done appropriately and after 7,14 and 28 days results of compressive strength measured by applying gradual load.
- Flexural and split tensile test have been done after 28 days.
- By observing the result we come to know we can achieve maximum 25% of wollastonite can be replaced which gives us a good result and achieved characteristic strength for M40 and M30 grade of concrete.
- After that if we increase the percentage of wollastonite the rheological properties of concrete changes.

8. REFERENCES

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