IJEAST

INTERNATIONAL JOURNAL
OF ENGINEERING APPLIED SCIENCE
AND TECHNOLOGY

VOLUME : 2 ISSUE : 8 Print / Issue Publication Date: 12-Feb-2018

ISSN : 2455-2143

Indexed In

Google SCHOLAR OPEN ACCESS doi Crossref

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International Journal of Engineering Applied Sciences and Technology, 2017
Vol. 2, Issue 8, ISSN No. 2455-2143, Pages 75-79
Published Online December 2017 in IJEAST (http://www.ijeast.com)

DEVELOPING ALCCOFINE BASED HIGH STRENGTH SELF COMPACTING CONCRETE

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***Abstract*— Self compacting concrete (SCC) is an innovative concrete that does not require vibration for placing as it becomes dense due to its own self weight. SCC is a high performance concrete (HPC) which meets special performance and uniformity requirements In the present investigation high strength self-compacting concrete of grade M80 is developed using mineral admixtures such as Alccofine and fly ash .the mix design was done by using Japanese method by following EFNARC guidelines. The flow properties of resulting concrete is characterized in the fresh state by methods used for Self compacting concrete, such as Slump-flow, V-funnel and L- box tests respectively.**

Keywords— **Self-compacting concrete, Compressive Strength, Fresh properties**

I. INTRODUCTION

The present day, world is witnessing the construction of very complicated and difficult engineering structures. Concrete being the most important and widely used material is called upon to possess very high strength and sufficient workability properties. Efforts are being made in the field of concrete technology to develop such concrete with special performance characteristics.

Self-compacting concrete (SCC) was first developed in 1986 in Japan to achieve durable concretes structures. SCC is defined as a category of high performance concrete that has excellent deformability in fresh state and resistance to segregation and bleeding that can be placed and compacted under its own weight without applying vibration. The use of SSC facilitates the placement of concrete in densely reinforced members through restricted sections. Such concrete must achieve excellent deformability, low risk of blockage and good stability of formwork to ensure high filling capacity.

SCC has a low yield stress and a moderate viscosity to ensure high filling ability and segregation resistance, proper resistance segregation is essential to prevent blockage and ensure homogeneous deformation of the concrete through congested reinforcement. High-Performance Concrete is being widely used throughout the world and to produce them it is necessary to reduce the water/binder ratio increase the binder content and by using mineral admixtures.

II. PROPOSED ALGORITHM

A. Experimental programme

The main objective of experimental testing is to study compressive strength and fresh properties for m80 grade high strength self-compacting concrete mix.

Materials Used:

In this study, the raw materials were collected from the locally available resources from the market.

A. Cement

OPC 53 grade (IS: 12269-1987) was used cement sample was tested for physical properties:

B. Aggregate

The aggregates (coarse & fine) are obtained from Khirabad Quarry. Aggregates were tested for physical properties such as specific gravity, water absorption and organic impurities grading and moisture content of aggregates. The aggregate crushing value and impact value was determined.

C. Alccofine

Alccofine 1203 is a specially processed product based on slag of high glass content with high reactivity obtained through the process of controlled granulation. Alccofine 1203 have used conforming to ASTM C989-99. Physical & Chemical Properties of Alccofine is given in table 1&2

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Table -1 Physical Properties of Alccofine

Fineness (cm^2/gm)	Specific Gravity	Bulk Density (kg/m^3)	Particle Size Distribution (μ)		
			d10	d50	d90
>12000	2.9	700-900	1-2	4-5	8-9

Table -2 Chemical Properties of Alccofine

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

D. Fly ash

Fly ash was obtained from thermal power plant at Ropar, Punjab has been used in this project. Physical properties and chemical properties of fly ash used are as shown in the table 3 & 4, below.

Table-3 Physical properties of fly ash

Sr. No.	Property	Fly ash
1	Specific Gravity	2.2
2	Blaine's Fineness(cm^2/gm)	3260

Table-4 Chemical properties of fly ash

Sr. No.	Constituents	Fly ash (%)
1	SiO_2	60.53
2	Al_2O_3	27.27
3	Fe_2O_3	4.18
4	CaO	1.04
5	MgO	0.40
6	Loss of Ignition	2.11

E. Super Plasticiser

BASF Master Glenium Sky 8866 is used as a super plasticiser. It is high-performance super plasticiser based on PCE (polycarboxylic ether) for concrete

F. Water

Portable water from the laboratory was used for mixing and curing.

III. Experiment and Result

Mix Design Concrete of grade M80 were designed as per Japanese method of mix proportions

Table-5 Mix Proportions

Cement (kg/m^3)	Flyash (kg/m^3)	FA (kg/m^3)	CA (kg/m^3)	Water (kg/m^3)	Alccofine (kg/m^3)	SP (%)
485	130	810	716	165	107	10.15

Fresh Properties of SCC

For each mix, slump flow test, L-box test, and V-funnel test were carried out. The test results of these are mentioned below.

Slump flow value

The consistency and workability of SCC has been assessed using the slump flow test.. In this study the diameter of concrete flowing out of the slump cone has been obtained by calculating average of two perpendicularly measured diameters. Flowing ability is measured by slump flow test. The slump flow ability obtained from the mixes has been presented in table 4.1. The higher the slump value greater is the ability to fill formwork under its own weight. Slump flow value is achieved were in range 750 to 760 mm. Figure 4.1 showing the various slump recorded for TM6 mix.

Table -6 Slump Cone Test

Sr. No.	Slump Flow values by Abram's Cone (in mm)	
	Horizontal Slump (in mm)	T50-Time (in sec)
1	754	2.94
2	756	2.90
3	752	2.92
4	753	3.0

From the table-6, it can be observed that the slump flow is within the range of 752to 756 and flow time ranging from 2.90to 3 seconds.

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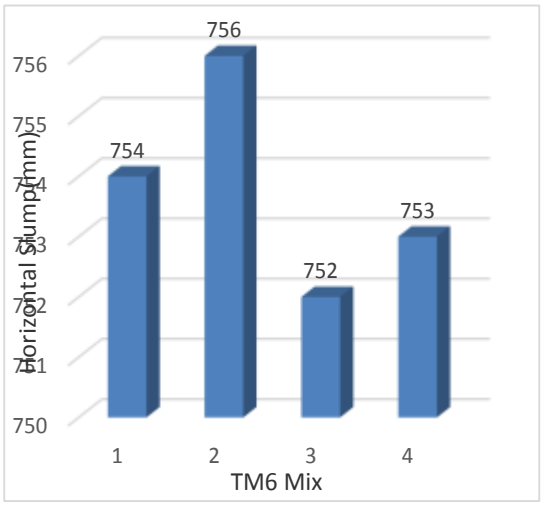

Figure-1: Slump value

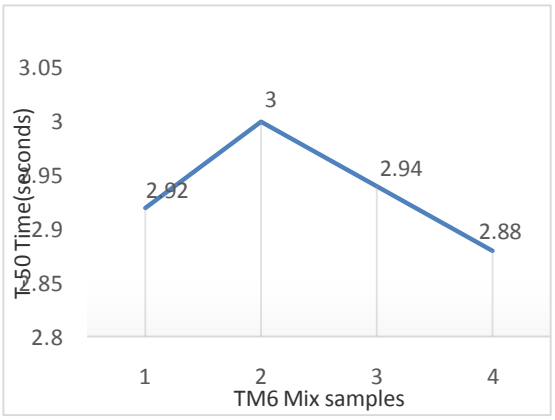

Figure-2 T-50 time for TM6 Mix

V-FUNNEL TEST

V-funnel is used to determine the filling ability (flowabiliy) of concrete. Shorter the flow time greater is the flowabiliy. The inverted shape cone restricts the flow and prolonged flow time may give indication of the susceptibility of mix to the blocking.

Segregation of concrete will show a less continuous flow with increase in flow time. The flow time observed was between 7.56 to 8.0 seconds which is in EFNARC guidelines. The $T_{5\ min.}$ time was observed between 8.10 to 8.30 seconds. Table-7, shows the time in V-funnel test.

L-BOX

L-box blocking ratio indicates the degree to which the passage of concrete through the bars is restricted if concrete flows as freely as water the blocking ratio is H_2/H_1 is one. This test assesses the passing ability of self-compacting concrete from the observation recorded, it has been observed that blocking ratio ranges between0.952 to 0.960 . Showing the values of blocking ratio under table 8.

Table -7 V-funnel Test

Sr. No.	V-Funnel Values	
	Flow Time (in sec)	$T_{5\ min.}$ (in sec)
1	7.56	8.12
2	7.6	8.20
3	8.1	8.0
4	8.0	8.30

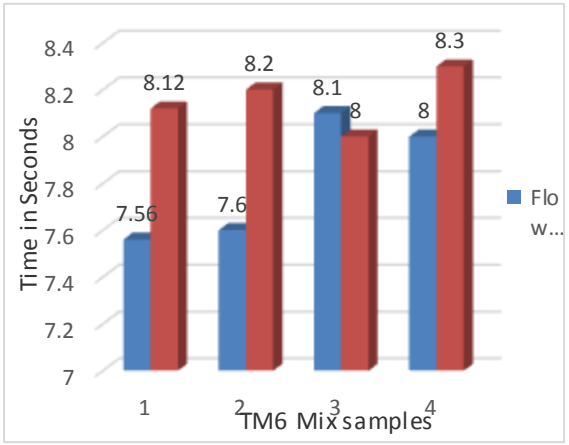

Figure 3 Comparison of Flow time and T_{min} time

Table-8: L-Box Test

Sr. No.	L-BOX values
	H2/H1
1	0.956
2	0.954
3	0.960
4	0.952

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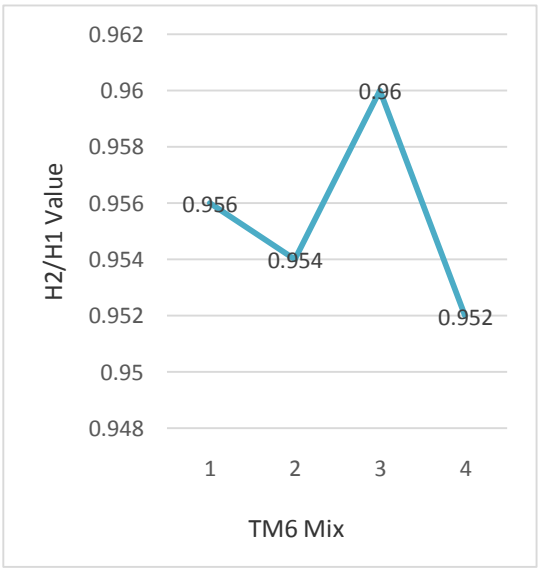

Figure 4 L Box

COMPRESSIVE STRENGTH OF SCC

The compressive strength of concrete is very important, as it is used more often in compression than in any other way. It is often taken as index of the overall "quality" of concrete. The values of compressive strength observed are shown in table-9

Table-9 Results of the Compressive strength

Specimen	Compressive strength							
	7 Days		28 Days		56 Days		90 Days	
1	60.2	56.9	90.6	91.7	92.5	93.4	93.4	94.3
2	57.7		93.4		95.4		96.1	
3	55.1		92.4		93.8		94.2	
4	55.4		89.2		91.2		92.6	
5	56.2		93		94.1		95.1	

From Table 9 it is observed that the SCC developed has compressive strengths at the end of 7 days ranging from 55.1 to 60.2 MPa and at the end of 28 days compressive strengths ranging from 89.2 to 93.4 MPa. And at the end of 56 days strength ranges from 91.2 to 95.4 MPa and at the end of 90 days it was observed to be ranges from 92.6 to 96.1 MPa.This is due to higher dose of Alccofine as compared to other mixes .Due to finer material size as compared to cement and flyash,addition of Alccofine has resulted in plugging the voids spaces and hence giving dense matrix in the concrete and increase in strength.

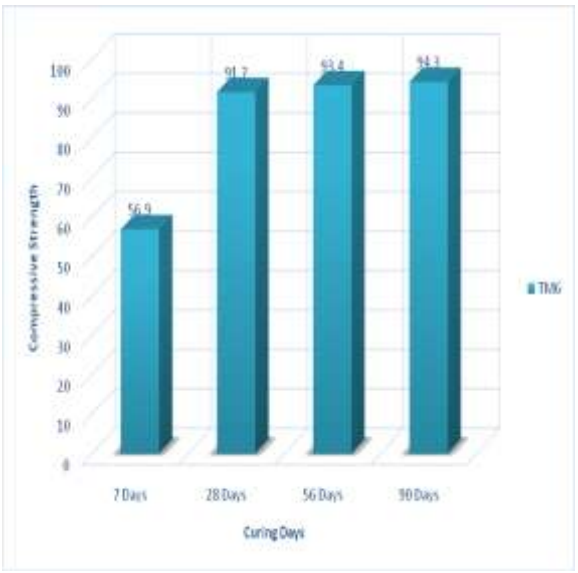

Figure-:5 Compressive strength of control concrete TM6 at 7, 28, 56 and 90 days

IV. CONCLUSION

- The study illustrate that it is possible to design HSSCC by using Alccofine and fly ash.
- The addition of Alccofine and fly ash in SCC improves microstructures of concrete that was helpful in enhancing the mechanical properties of concrete developed.
- Use of Alccofine and fly ash reduces the utilization of cement due to which CO_2 emmision is also reduced.
- By adding fly ash the problem of its disposal is eliminated and encroachment on the costly land and air pollution is avoided.

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