International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.03, April 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

Enhancement of Plastic Stage Properties of Self Compacting Concrete Using Nano Composite Particles

Patil Hiteshkumar Santosh [1], Arunkumar Dwivedi [2], Aniruddha Chatterjee [3]

[1]*Sandip Institute of Engineering & Management , Nasik (MS) India*

[2]*Sandip University Nasik (MS) India*

[3]*Maharashtra Institute of Technology Aurangabad (MS) India*

ABSTRACT

In Present research paper the study emphasis on improving workability of self compacting concrete. Waste product from industries and its disposal is a very serious problem now a day. If waste accumulated in the atmosphere can cause severe damage to environment and disturb ecological balance. In this research study two waste products from paint industries is taken into consideration these are Zinc Dust & Blast Grit. It is available in the form of dust particle having its size nanometer, if dispose to atmosphere directly can cause severe damage to living being. If this waste product is used in Self Compacting Concrete in 0 to 5 % of by weight of Cement & fine aggregate then workability of green SCC is increase near about 37 %.

Keywords**:** *SCC, V funnel, L Box, U box, Nan Su Method, Zinc Ash, Blasting Grit*

I. INTRODUCTION

Behaviour of concrete, such as, smoothness and high opposition to segregation permit the placement of concrete without vibrations of concrete in very dense reinforcement area in very short period of construction. This behaviour also helps in decreasing in labour and material cost, noise. Self Compacting Concrete overcome problem of compaction, fluidity. With the incremental use of Self Compacting concrete in various sectors especially in precast industries the research in SCC also increase now a days.

The ever increasing need of zinc as a coating material on steels has compelled the galvanizers to relook on the economic and effective use of this material. The annual worldwide consumption of zinc for hot Clip galvanizing is around 600000t. The effective utilisation of zinc in different galvanizing plant throughout the world averages 78% but in our plant it comes to 58% only. The world average of zinc loss as zinc ash is 3% in hot dip galvanizing. Of late, increased attention is being paid the world over for the recovery of scarce material from industrial waste. Particularly in India, it has drawn a great deal of importance as the country at present is not self sufficient in the production of zinc and has to import a substantial amount every year. [1]

Essentially, zinc ash is mixture of metallic zinc, zinc oxide, chlorine compounds and acid insoluble impurities. Zinc ash is formed as the molten zinc on the top of the galvanizing bath gets oxidised by the atmosphere. This process continues with the removal of' the zinc oxide layer from the bath, whereby a new metallic zinc surface is exposed to the atmosphere. When ash is removed from the zinc bath, it also takes along some pure zinc with it from the bath. Composition of zinc ash has been found to be in the following range: Zinc - 60 - 85%, Chlorides - 2 - 12%, Lead - 0.3 - 2.50/o Aluminium - 0-0.3%, Iron - 0.2 - 1.5% [1]

Grit blasting is a process by which abrasive particles are made to impinge on a component to clean or modify its surface properties. Particles range from walnut shells (relatively soft), through various sands, to silicon carbide, alumina or emery particles, depending on the application. Methods of propelling the particles also vary and include entrainment in compressed air, liquid (usually water) or vapour (usually steam) streams, and mechanical projection methods (e.g. rotating paddles).Grit blasting is used to remove sand and scale in the fettling of castings, and for dressing of stampings and billets, etc. It is often used to prepare surfaces before welding (removal of scale, rust or paint), and afterwards to improve the adhesion of coatings (e.g. paint, or galvanising).The impact of the grit on the metal surface puts the surface layer into compression, and this effect can be beneficial, for example, in reducing stress corrosion cracking in aluminium alloys.[2]

II. EXPERIMENTAL SETUP

Table 1 Experimental Set Up

III. TESTING OF MATERIALS

Table 2 Test Result

Portland Pozzolana Cement 43 grade		**Aggregates**	
Fineness Test	0.02	**Sand**	**Coarse Aggregate**
Initial Setting Time	35 min	FM- 3.5	FM- 2.46
Final Setting Time	3.5 hrs	SG-2.65	SG-2.7
Soundness Test	1.8 mm	Bulkdensity-1500 kg/m^3	Bulk density-1530 kg/m^3
Blasting Grit Average Size	114 nm	Zinc Ash Average Size	49 nm

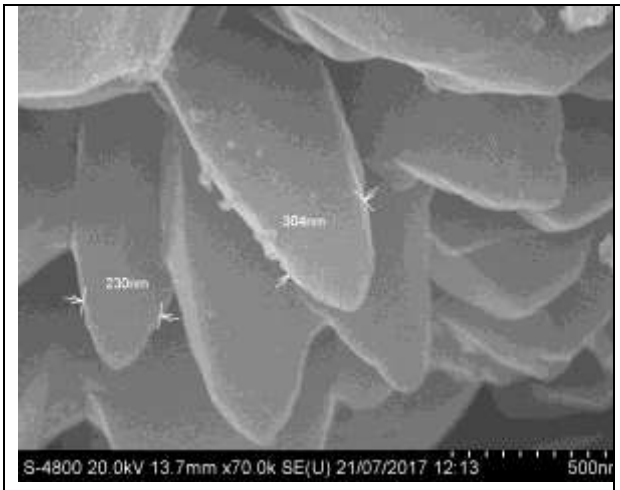

Figure A- SEM ANALYSIS OF BLASTING GRIT-1

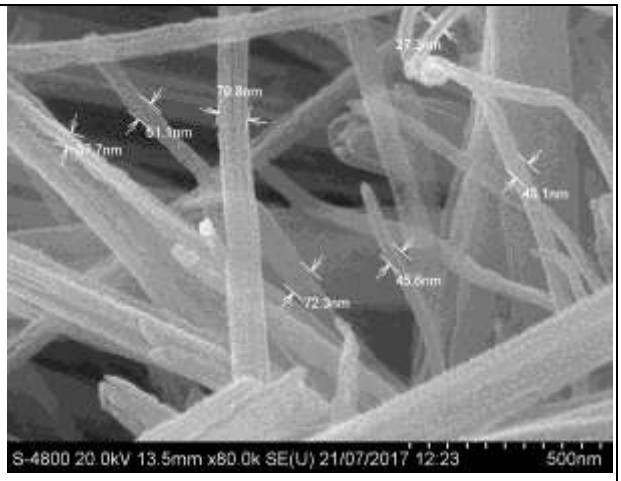

Figure B - SEM ANALYSIS OF ZINC ASH -1

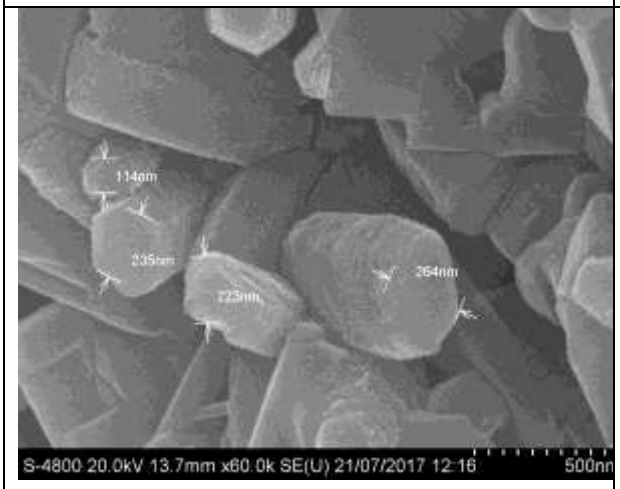

Figure C- SEM ANALYSIS OF BLASTING GRIT-2

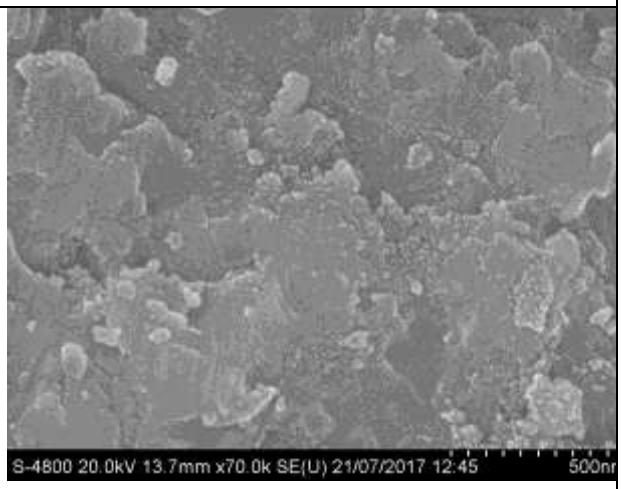

Figure D - SEM ANALYSIS OF ZINC ASH -2

IV. CONCRETE MIX DESIGN

For this experimental work, Combination of Nan Su Method [3] & Indian Code method for Concrete Mix Design is adopted. A simple excel sheet based on Nan Su Method is prepared later on it is compare with IS 10262 (2009) method [4]. The major change in this design is the cement content, as per Nan Su method the cement content is less than minimum cement content given IS code, therefor the adopted cement content for this experimental work is more than minimum cement content given in IS 10262(2009). The data use for concrete mix is as follows.

International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.03, April 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

Table 3 CONCRETE MIX DESIGN BY COMBINATION OF NAN SU METHOD & IS 10262(2009)

Sheet Prepared By Hitesh Patil								
1)	SCC Compressive Strength	=	5731	**psi**	=	**40**	Mpa	for 28 days
2)	MSA	=	**10**	**mm**				
	Coarse aggregate							
1)	SG	=	**2.7**					
2)	Bulk density(loose)	=	**1350**	**kg/m3**				
	Fine aggregate							
1)	SG	=	**2.64**					
2)	Bulk density(loose)	=	**1300**	**kg/m3**				
	Packing Factor from table	=	**1.14**					
1)	SG of cement	=	**3.15**					
2)	SG of fly ash	=	**2.15**					
3)	SG of Super Plasticizer(SP)	=	**1.02**					
4)	Air Content in SCC	=	**1.5**	**%**				
5)	W/C	=	**0.4**					
6)	Fine Aggregate / Coarse aggregate	=	**49** / 51	Water (W) / Fly Ash(F)	=	0		
7)	Density of cement	=	**1470**	**kg/m3**				
8)	SP dosage	=	**2**	**%**				

Mix Proportion used – C: FA: CA = 1: 1.06: 1.15

Material Quantity per Meter Cube as follows:

Table 4 Quantity of Material for 1 meter Cube

Material	Qty	Unit	Material	Qty	Unit
Cement =	400	kg/m3	Fine Aggregate =	726	kg/m3
Fly Ash =	284	kg/m3	Coarse aggregate =	785	kg/m3
Super Plasticizer =	15.7	kg/m3	Water =	150.6	kg/m3
W/C =	0.4	Super Plasticizer Dosage=		2% of Cement	Kg/m^3

V. PREPARATION OF SAMPLE

Following mix types are prepared with addition of Nano Composite Particles.

Table 5-Modification in Mix

Mix Type	Modification 1	Modification 2
M 1	Z A- 0% of C	B G- 0 % of FA
M 2	Z A- 2.5% of C	B G- 2.5% of FA
M 3	Z A- 5% of C	B G- 5% of FA

Where – M- Mix, Z A – Zinc Ash, B G- Blasting Grit, C- Cement, FA- Fine Aggregate

International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.03, April 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

VI. EXPERIMENTAL TEST

Workability Test Results

As per EFNARC (European Federation of National Associations Representing for Concrete)

Table 6 Test Result

Test	Description	Acceptance Criteria	Remarks	M1 Result	M2 Result	M3 Result
1. V funnel	Asses flow ability & segregation	T_0 – 8 to 12 sec	If T_5>(3+T_0) cause segregation	10 sec	9 sec	7 sec
		T_5 < (T_0 – 3) sec		2.5 sec	2 sec	1.9 sec
2. U Box	Asses Pass ability	h_1-h_2 = 30mm	If value more than 30 shows low viscosity , value =1mm concrete easily pass through	8 mm	5 mm	2 mm
3. L Box	Measure Passing Ability	h_2/h_1 = 0.8 to 1	If h_2/h_1<0.8 means viscosity too High	0.92	0.84	0.8

VII. RESULTS AND DISCUSSION

Table 7 Workability Result Comparison

Test	M1	M2	M3
V funnel	10 sec	9 sec	7 sec
	2.5 sec	2 sec	1.9 sec
U Box	8 mm	5 mm	2 mm
L Box	0.92	0.84	0.8

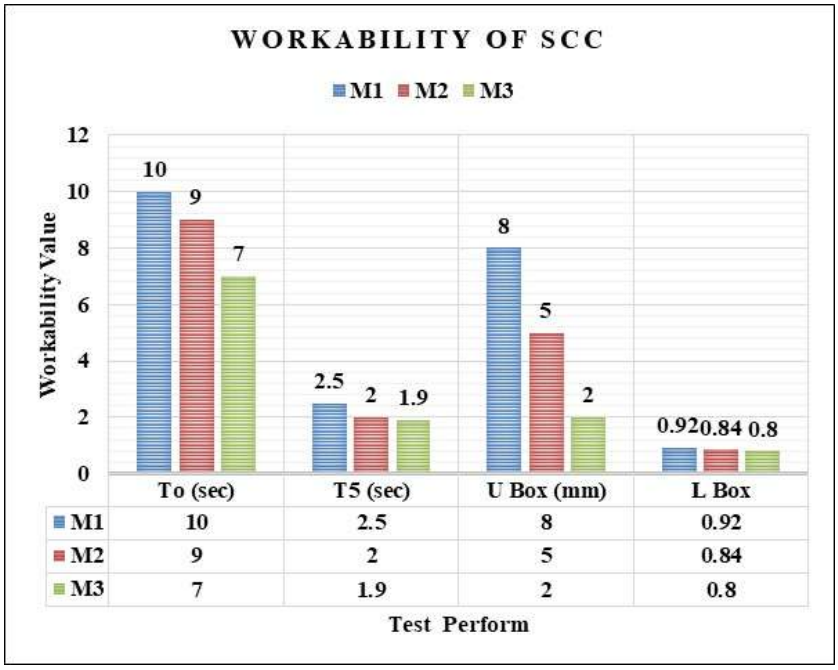

Figure E WORKABILITY COMPARISION

Percentage increase in workability as compare with normal SCC

Table 8 Percentage Increase in Workability

Test	M2	M3
T0	10.00	30.00
T5	20.00	24.00
U Box	37.50	75.00
L Box	8.70	13.04

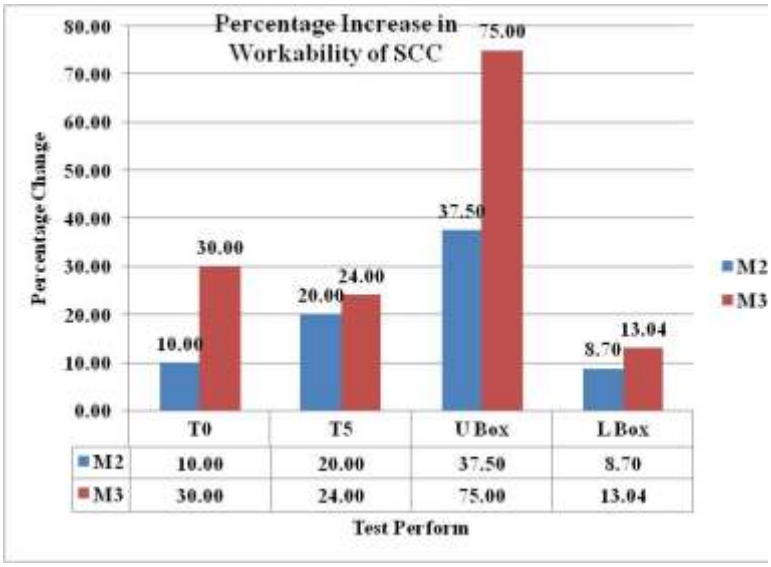

Figure F PERCENTAGE INCREASE IN WORKABILITY

In this experimental work the addition of Nano composite particles varies from 0 to 5 %.As addition of Nano composite particle increases the filling ability, resistance to segregation, passing ability of self compacting concrete is increase. Details result about test is shown in above graph.

VIII. CONCLUSION

- The filling ability of SCC as per V funnel T_0 & T_5 is directly proportional to the percentage of addition of Nano particles
- As amount of Nano composite particles increases the resistance to segregation also increases.
- The passing ability of Nano composite particles also increases with addition of Nano composite particles.
- Percentage increase in filling ability is 10 to 30 % as per To test & 20 to 24 % as per T5 test.
- Percentage increase in passing ability is 37 to 75 % as per U Box test.
- Percentage increase in passing ability is 8.7 to 75 % as per L Box test.

Future Scope: The same work will repeated for increasing mix proportion of Nano composite materials for different grade, also replacement of cement & fine aggregate is also compare.

Acknowledgements

I am whole-heartedly grateful to my supervisors, Prof A.K.Dwivedi & Prof A Chatterji , whose encouragement, guidance and support from the initial to the final level enabled me to develop an understanding of the subject. Lastly, I offer my regards and blessings to all of those who supported me in any respect during the completion of the experimental work.

References:

[1]. Recovery of zinc from zinc ash- Dr.R Jha TATA STEEL

[2]. www.twi-global.com/technical-knowledge/faqs/faq-what-is-grit-blasting

[3]. Nan Su [a]*, Kung-Chung Hsu [b], His-Wen Chai[c] " A simple mix design method for self-compacting concrete" Cement and Concrete Research 31 (2001) 1799–1807

[4]. IS 10262 Indian Standard code for Concrete Mix Design

[5]. Self Compacting Concrete, Ambuja Technical Literature Series (98)

[6]. L. P. Singh, S. R. Karade, S. K. Bhattacharyya, M. M. Yousuf, S. Ahalawat, Beneficial role of Nanosilica in cement based materials – A review, Construction and Building Materials 27 (2013) 1069–1077.

[7]. F. Sanchez, K. Sobolev, Nanotechnology in concrete – A review, Construction and Building Materials 24 (2010) 2060–2071.

[8]. P. Niewiadomski, Short Overview of the Effects of Nanoparticles on Mechanical Properties of Concrete. Key Material Engineering 662(2015) 257–260.

[9]. A. Nazari, Computer-aided prediction of physical and mechanical properties of high strength concrete containing Fe2O3 Nanoparticles, Cement WapnoBeton 5 (2012) 265–285.

[10]. A.Nazari, G.Khalaj, S.Riahi, M. J.Khalaj, The influence of Al2O3 Nanoparticles on the properties of traditional concrete with granulated blastfurnace slag as binder, Cement WapnoBeton 6 (2011) 311–322.

[11]. A.Nazari, S.Riahi, Abrasion resistance of concrete containing SiO2 and Al2O3 Nanoparticles in different curing media, Energy and Buildings 43 (2011) 2939–2946.

[12]. A.Nazari, S.Riahi, Effects of CuO Nanoparticles on compressive strength of self-compacting concrete, Sadhana 36/3 (2011) 371–391.

[13]. A.Nazari, S.Riahi, The effects of Cr2O3 Nanoparticles on strength assessments and water permeability of concrete in different curing media, Materials Science and Engineering a 528(2011) 1173-1182.